Digital Photogrammetric System

PHOTOMOD

Version 5.21

USER
MANUAL

Orthomosaic Building

RACURS

1. General info

Program **PHOTOMOD Mosaic** is used for orthorectification and mosaicking of images of the source block. The output "block" orthoimage (**orthomosaic**) may be also split into quadrangle sheets selected by user.

As a result of orthorectification process all distortions caused by geometry, perspective, tilt and relief are removed so that all features in an orthoimage are in their true orthographic positions. Created orthomosaic is georeferenced to selected coordinate system and has a cell size defined by user. Tools of brightness adjustment and creation of **regions of interest (ROI)** – fragments of each source image included to the output mosaic, are also available. Borders of regions of interest are named **cutlines**.

2. Installation and starting of PHOTOMOD Mosaic

PHOTOMOD Mosaic is not a stand-alone program and can be started with **Project | Mosaic** menu command or by **PHOTOMOD Core** toolbar button.

3. Recommended procedure of orthomosaic building

Prior to orthomosaic creation you should specify block boundaries, output sheets size, orthophoto pixel size, map scale as well as output file format and georeference type. Digital elevation model (DEM) on the block is usually built in **PHOTOMOD DTM** module and could be used for orthorectification process. In this case TIN with linked breaklines also is used as input data.

Make the following operations to create orthomosaic:

1) Build DEM in **PHOTOMOD Core** with cell size multiple to the input mosaic cell size. Recommended ratio between these values (**Interpolation cell size**) is 20-40. For example, if you need to create orthoimage with pixel size 0.3 (m), you should assign interpolation cell size to **20**. Then assign cell size for DEM building to 6 (m). South and west DEM boundaries should be assigned to appropriate block boundaries. After that start DEM building.

2) Start **PHOTOMOD Mosaic** from **PHOTOMOD Core** by pushing the icon in main toolbar or menu command **Project | Mosaic**. Open **Parameters** window in **PHOTOMOD Mosaic** program (main panel icon , menu command **Mosaic | Parameters** or by **Ctrl-Alt-M** shortcut (if there is a stereopair selected in 2D-window)). Setup "Cell size" parameter on **Orthoimage** tab and select the **DEM** option on **Type of DTM** tab (see the chapter External DEM). Then check the parameter **Interpolation cell size** on the same tab, it equals **20** in this case and the value is unavailable for changing.

If initial images contain the objects which are considerably towering over the relief (bridges, for instance) you should load 3D vectors describing them and turn on the option **Use breaklines** (**Type of DTM** tab). Otherwise such objects could be deformed on orthomosaic. Also it is necessary to build the vectors into initial TIN.

3) Usually the initial images of the block have considerable brightness and color differences and additional processing is required to obtain visually continual orthophotomosaic. For such processing you should set global and local brightness adjustment parameters on **Brightness adjustment** tab in **Parameters** window. If the neighbour images of the block differ in brightness and color you should use **By average brightness** option for global adjustment.

The local adjustment improves the brightness inside each image. In most cases it is recommended also to use **Seams feathering** option for brightness differences adjustment on merging edges of the images (see the chapter Brightness adjustment).

4) Draw regions of interest (ROI) on the initial images according to the rules described in the chapter Cutlines creating rules. On this stage you can also exclude unused images from the project and set the order ("upper-lower") of images supposed to be included to the resulting mosaic.

5) If you would like to split the resulting orthomosaic into sheets, check the option **Regular splitting** on **Split into sheets** tab and set sheets boundaries (south and west) and size in **Splitting parameters** window opened by the **Parameters** button on the same tab (see the chapter Splitting mosaic into map sheets). After pushing the **Apply** button sheets number is calculated automatically. You can correct this number if needed and close **Splitting parameters** window and also **Parameters** window by the **OK** button.

6) Build mosaic preview (see the chapter Mosaic preview) and check that all sheets are inside the DEM boundaries. If some of them are out you could correct DEM boundaries to extend them otherwise the parts of sheets located outside the DEM will be colored as a background.

7) If brightness and color differences are not properly adjusted and are visible on preview, you should change local adjustment parameters and global adjustment type. You can also change cutlines close to unsatisfactory parts of image to improve the local adjustment. All these efforts lead to the required brightness quality.

8) In **Parameters** window on **Orthoimage** tab (opened by menu command **Mosaic | Parameters**) you can set the parameters of the orthoimage file compression (if necessary), as well as background color and georeference file type. After pushing the **Scale** button an additional panel is opened allowing you to input the scale of resulting mosaic (by filling in **Orthoimage scale** field) and also to recalculate its size and resolution (see the chapter Orthoimage).

9) After that start creating orthomosaic with preset parameters. See the chapter Building orthomosaic.

Note.

*1. After each mosaic building stage mentioned above, save mosaic project to PHOTOMOD system resource*

2. You can also make cutlines and brightness adjustment prior to DEM creating. In this case it is recommended to check the option "Control points interpolation" on Type of DTM tab

4. Main program menu

After starting, **PHOTOMOD Mosaic** opens a window with a main menu in its upper part.
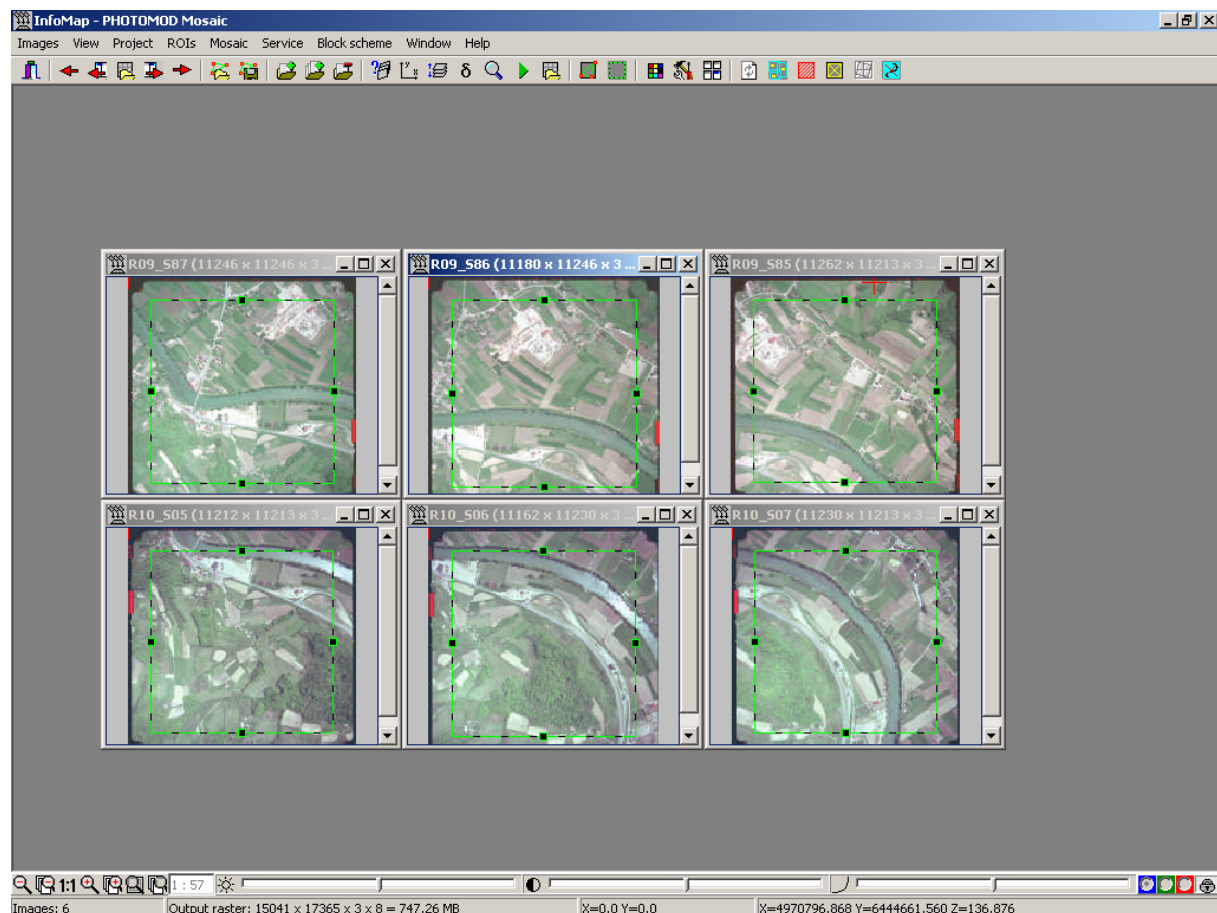
PHOTOMOD Mosaic user interface

The main **PHOTOMOD Mosaic** menu consists of the following items.

4.1. *Images*

Images menu is used for loading source images to **PHOTOMOD Mosaic** and includes the following options:

- **Open** (duplicated by the ⊞ icon of the main icon bar or hot keys **Ctrl-O**) – opens a list of the source rasters for selection and loading a single image (see the chapter Working with a single image). While loading rasters (basically for ROI creation and editing) you can open unlimited number of windows. You can use standard OS Windows tools (**Shift** and **Ctrl** keys) for group selection of source image files in the window with images list. And also you may search for image in the list by its name

- **Next image** (duplicated by the ➡ icon of the main icon bar or hot keys **Ctrl-N**) – loads the next image of the source block to the current window

- **Previous image** (duplicated by the ⬅ icon of the main icon bar or hot keys **Ctrl-P**) – loads the previous image of the source block to the current window

- **Current + next** (duplicated by the ➡ icon of the main icon bar) – opens 2 windows – with the current and next images

- **Previous + current** (duplicated by the ⬅ icon of the main icon bar) – opens 2 windows – with the previous and current images
- **Remove non-existing** - search and removal of non-existing rasters.

- **Background color** option - allows you to set the background color of the original images, containing non-informative data like the background with a constant value of brightness and color. To manually set the background color for these images, you should select **Images | background color | Set color**, which opens the **Background color** window.
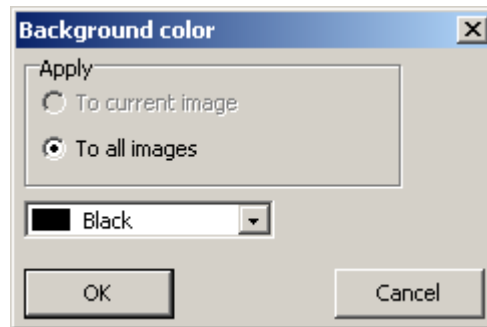
In case a window with one of the source images is open, it is possible to set the color for that image only. Also it is possible to set the background color for all images in the mosaic project.

In case the background is concentrated at the edges of images (for example, due to rotated raster), it possible to automatically define it for each of the images. In order to do it, you should check the **Images |Background color | Automatically** option.

If it is necessary to cancel selection of background for one or all images it is necessary to check the **Images |Background color | None** option, which opens the **Background color** window.
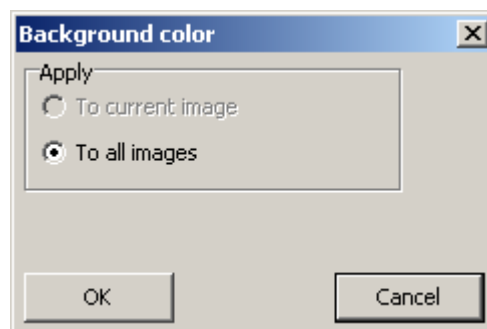
In order to make the specified background color transparent, you should use menu command **Images | Background color| Transparent background** when building mosaic

- **Exit** (duplicated by the ▯ icon of the main icon bar or hot keys **Ctrl-X**) – exits **PHOTOMOD Mosaic**.

Note. In case the PHOTOMOD project has been restored with an incomplete set of rasters, before start of work you should execute the "Images | Remove non-existing" command.

A list of recently opened images is maintained for more comfortable operation. This list is called by **Images | Recent list** menu command. An image is opened by clicking on corresponding list item.

4.2. *View*

This menu is intended for setting the image view in active window or in all windows. At that there are the following options:
- **Hide all** – hides all objects
- **ROIs** – shows/hides regions of interest (ROI's): all or user defined, duplicated by button bar icon or **Alt-Z** hot keys
- **Cutlines** – shows/hides *cutlines* on the image. Cutlines are borders of ROI's which are used to build resulting mosaic (see the chapter Cutlines creating rules)
- **Breaklines** – shows/hides breaklines involved to the orthorectification process (if the option **Mosaic | Parameters | Type of DTM | Use breaklines** is **ON**) or available in current **PHOTOMOD** project. At that you can select breaklines resources in the window, appeared after pushing the PHOTOMOD button, located on the same panel.
- **Triangulation points** – shows/hides triangulation points (in preview or mosaic window), duplicated by icon
- **Local adjustment** – in preview or mosaic window turns on/off small rectangles marking the places where local brightness adjustment statistics was taken (see the chapter Local brightness adjustment)
- **DEM** – shows/hides schematic DEM created during the project processing (see the **Project processing** User Manual), duplicated by icon
- **Show in all windows** – shows/hides all abovementioned objects in all windows: source images, preview and mosaic.

4.3. *Project*

This menu is used to work with *Mosaic project* – **PHOTOMOD** system resource, which stores all settings such as brightness, contrast and gamma of images, regions of interest and parameter values. **Project** menu consists of the following options:
- **New** – restores all preview and mosaic building settings into initial ones without module exit, that allows to create new Mosaic project
- **Open** (duplicated by the icon of the main icon bar) – opens a window for selecting **PHOTOMOD** resource with mosaic project for loading. Allows also to open the project from backup copy, if the appropriate option is selected, see the chapter Preferences.
- **Save** (duplicated by the icon of the main icon bar) – opens a window for selecting **PHOTOMOD** resource name for mosaic project saving
- **Save as** – opens a window for selecting **PHOTOMOD** resource name for mosaic project saving with name different from initial
- **Import** – allows to import several **PHOTOMOD Mosaic** projects into a common one, that is useful when ROI's are created by several operators, see the chapter Import of PHOTOMOD Mosaic project
- **Add images** (duplicated by the icon of the main icon bar) – selecting source images for including to the mosaic project. By default when starting **PHOTOMOD Mosaic** all images of the source block are loaded, but in some cases you may want to orthorectify only a portion of the block so you can add and remove images. Use standard OS Windows tools (**Shift** and **Ctrl** keys) in this window for group selection of images to be added. Search of the image in the list by its name is also available

- **Add from other project** (duplicated by the [icon] icon of the main icon bar) – selecting source images from other project for including to the current mosaic project (see the chapter Using images form other projects)

- **Remove images** (duplicated by the [icon] icon of the main icon bar) – opens the window with images list of the current project for removing selected images. Use standard OS Windows tools (**Shift** and **Ctrl** keys) in this window for group selection of images to be deleted. Search of the image in the list by its name is also available. Restart the **Mosaic** module to let the changes take effect (to hide removed image from the block scheme, for example).

4.4. *Regions of Interest*

This menu is used to create regions of interest (ROI) – see the chapter Creating regions of interest. ROIs are fragments of each source image included to the output mosaic. The menu includes the following items:

- **ROIs editor** (duplicated by the [icon] icon of the main icon bar) – opens additional button bar used for creating and editing of Regions of interest. See the chapter Creating and editing regions of interest

- **Trim off images edges** (duplicated by the [icon] icon of the main icon bar) – used to change a size of rectangular default ROIs. See the chapter Default regions of interest
- **Polygon ⇔ rectangle** – converts selected ROI to the rectangle for the current image. In this case the ROI becomes available for editing as described in the chapter Creating and editing regions of interest
- **Polygon ⇔ rectangle for all** – the same operation for all images
- **Autobuilding** – automatic ROI creation on selected image
- **Delete all ROIs** – cancels ROIs creation and shows default ROIs. See the chapter Regions of interest by default
- **Cutlines accuracy report** – allows to create a report on accuracy control on cutlines, see the chapter 10.2 On cutlines

- **Update cutlines on neighbor images** (duplicated by the [icon] icon of the main icon bar) - speeds up update of cutlines of neighbor images.
- **Load ROIs** – loading ROIs from PHOTOMOD vector resource. See the chapter Regions of interest import and export
- **Save ROIs** – saving ROIs to PHOTOMOD vector resource. See the chapter Regions of interest import and export
- **Save cutlines** – saving cutlines to PHOTOMOD vector resource. See the chapter Regions of interest import and export

4.5. *Mosaic*

This menu is used to start parameters selection and orthomosaicking process. It consists of the following options:

- **Parameters…** (duplicated by the [icon] icon of the main icon bar) – opens a parameters selection dialog (see the chapter Parameters and preferences)

- **Coordinates** (duplicated by the [icon] icon of the main icon bar) – opens a window of displaying and editing of the orthomosaic corners coordinates and also its width and length

- **Images order** (duplicated by the [icon] icon of the main icon bar) – opens a dialog of images order in the output mosaic (upper - lower). Used to process images overlapping areas (see the chapter Additional recommendations)

- **Accuracy control** (duplicated by the [δ] icon of the main icon bar) – estimates the orthorectification accuracy (see the chapter Orthorectification accuracy control)

- **Preview** (duplicated by the [icon] icon of the main icon bar) – shows mosaic preview with low resolution (see the chapter Mosaic preview).

- **Build** (duplicated by the [icon] icon of the main icon bar) – starts orthomosaicking process (see the chapter Building orthomosaic).

- **Open** (duplicated by the [icon] icon of the main icon bar or hot keys **Ctrl-Alt-O**) – loads previously created orthomosaic for viewing (see the chapter Loading orthomosaic).

- **Load vectors** – allows to load linear and point objects from PHOTOMOD vector resources and visualize them over resulting mosaic. Also user can load points as a set of coordinates X, Y, Z, by selecting the appropriate option. Loading vectors option is available if mosaic window is opened.

- **Create marginalia** – see the chapter Creating marginalia for orthophotomap.

A list of recently opened orthomosaics is maintained for more comfortable operation. This list is called by **Mosaic | Recent list** menu command. An image is opened by clicking on corresponding list item.

4.6. *Service*

Service menu consists of the following items:

- **Colors** (duplicated by the [icon] icon of the main icon bar). Used to set colors for displaying such objects as cutlines, DEM borders, selected ROI, and other objects.

- **Preferences** (duplicated by the [icon] icon of the main icon bar). Opens system preferences dialog (see the chapter System preferences).

- **Show regulation panel** (duplicated by the [icon] icon of the main icon bar or hot keys **Ctrl-T**) – shows/hides a panel with sliders for brightness/contrast/gamma corrections located in lower part of window.

- **Print window** – allows to print any active module window with pre-setting of printing options:
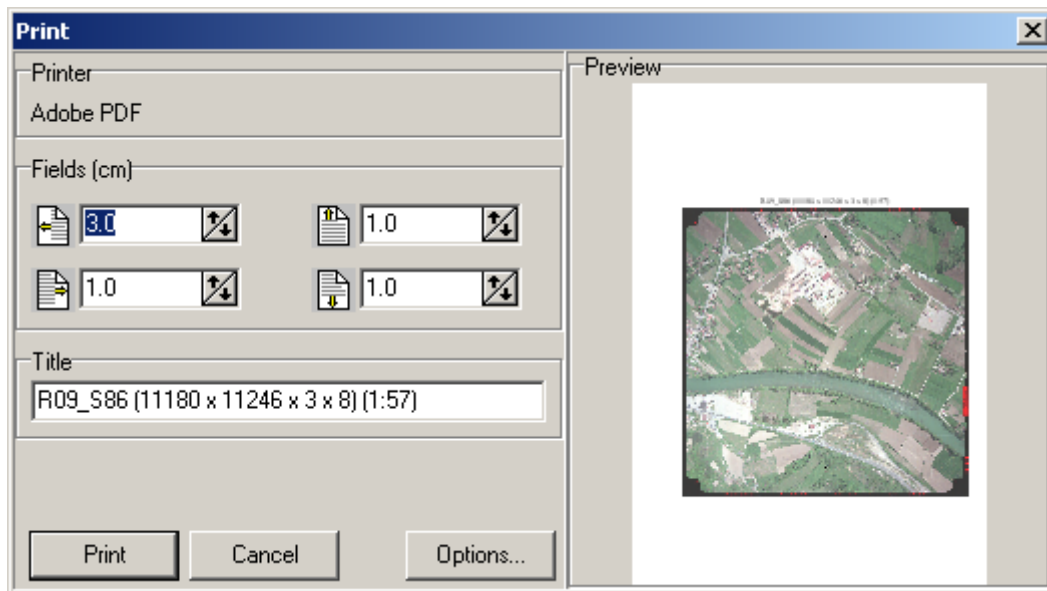
Printing options setting

Left part of this window allows to set up printing options: paper sheet fields, printer selecting and its settings (using the **Options** button), and also input the title of printed image in the appropriate field. You can preview all these settings in preview window in the right part of the window.

- **Print map** – allows to print any active module window with pre-setting of print options and splitting the image into sheets.

- **Execute PHOTOMOD Dust Correct** (duplicated by the icon of the main icon bar) – opens a window intended for cleaning mosaic image from artifacts, see the chapter Orthomosaic editing in Dust Correct application. If a window with any image (orthomosaic) was active when the command is executed, this image is automatically opened in Dust Correct (and closed on Mosaic).

- **Save DEM outline** – allows to save boundaries of DEM opened in the project into vector resource of PHOTOMOD system. See **Project Processing** User Manual.

- **Roofs vectorization** - a tool for outlining roofs of buildings on the source (non-orthotransformed) images and using this information during orthotransformation to shift the roofs to their true positions. See chapter Roofs vectorization.

4.7. *Block scheme*

- **Show** (duplicated by the icon of the main icon bar) – opens a *block scheme* on the screen. The relative position of the block images corresponds to the source input sequence (images and strips). The number of images to be displayed is defined in **Service | Preferences | Windows** panel (see the chapter Preferences). The block scheme is used for adding regions of interest (see the chapter Creating regions of interest) since it is convenient to see the ROI not only on the current but also on adjacent images.

- **Up** (**Ctrl-Alt-Up** hot keys), **down** (**Ctrl-Alt-Down** hot keys), **left** (**Ctrl-Alt-Left** hot keys), **right** (**Ctrl-Alt-Right** hot keys) – loads corresponding adjacent scheme portions. The overlap of the current and loading portions of the block scheme is set in the **Service | Preferences | Windows** dialog (see the chapter Preferences).

4.8. *Window*

Window is a standard menu item used to locate windows on the screen and includes the following options:
- **Cascade**
- **Tile vertically**
- **Tile horizontally**
- **Minimize all**
- **Close** – closes active window with current image
- **Close all** – closes all windows.

4.9. *Help*

Includes the following items:
- **Contents** (or **F1** key) – runs **Help** system for **PHOTOMOD Mosaic**.
- **About program…** – opens a window with information related to version number, serial number, date of version compiling, etc.

5. Working with a single image

5.1. *Loading images*

Images menu items described in the chapter Images are used for loading image to single image window.

5.2. *Creating Regions of Interest*

5.2.1. Regions of Interest by default

Orthomosaic is build by rectification of initial images. Image area, which is included to orthomosaic, is called *region of interest* (ROI) and its boundary – *cutline*.

Each source image has a rectangular region of interest (ROI) by default. This area excludes 10% of the image from each side just to make sure to avoid areas with *fiducial marks* from the output mosaic. You can change the size of this rectangular ROI using menu command

ROIs | Trim off images edges or by pushing the icon ![icon] (**Trim off images edges**) or by drag-and-drop the green cutline on the image. If you are not going to create more complex cutlines (for example based on the rules of the classic photogrammetry) you can just start building mosaic or preview image using these default ROIs. The images order in the output mosaic (which image is lower or upper in the overlapping area) is defined by the order

selected in the window opened by the ![icon] icon (**Images order**), see the chapter Additional recommendations. The source rectangles may be converted to 4-corner polygons using menu command **ROIs | Polygon ⇔ rectangle** (see the chapter Single image window). After that ROI becomes available for editing as described in the chapter Creating and editing regions of interest.

5.2.2. Cutlines creating rules

Cutlines are boundaries of **Regions of interest** – areas on the source images used to be rectified and merged to the output mosaic. It is recommended to draw cutlines manually to improve orthoimage quality, considering the following rules.

1. Draw ROIs as close as possible to the image principal point, to increase geometrical accuracy of images matching.

2. Cutlines should not intersect the objects which are considerably towering over the relief (bridges, tall buildings, power lines piers etc.). Otherwise the objects could furcate or partially disappear from the mosaic.

3. Cutlines should not go along the extended objects with brightness different from the main background (forest area boundary, road etc.). Otherwise the edge smearing effect occurs on the object boundary if the option **Seams feathering** is **ON**. It is recommended either to intersect such objects on the right angle or draw the cutline on some distance (not less than one and a half **interpolation cell size**, in pixels) from the boundary.

4. Re-draw the cutlines over alternating areas on the image with different color, or draw it in parallel with the objects boundary but on some distance from it, to avoid abnormally bright areas on the resulting orthoimage when local adjustment option is **ON** (see p.3).

5. The local adjustment works in such a way that images of each strip are adjusted first, and on the second step the strips are inter-adjusted. So the best situation is when ROIs borders inside every strip are "continuous" and the strips have some overlapping area. See also the chapter Additional recommendations.

5.2.3. Creating and editing Regions of Interest

Usually ROIs are created on each source image loading one by one. It is convenient to have on the screen two-three windows with adjacent images of the source block (see the chapter Images). To view a block fragment "around" the current image, open block scheme using the command **Window | Block scheme** or click the icon (see the chapter Block scheme).

ROIs are created using *cutlines editor* which opens by the icon or command **ROI | ROIs editor**. While adding ROIs you should create them with overlap to avoid "holes" on the output orthomosaic. For this purpose it is useful to see ROIs from adjacent images on the current one (push the icon of the main panel).

At that, the images order in the overlapping areas on resulting orthomosaic (upper-lower) corresponds with the sequence preset in **Images order** table (opens by the icon of the main panel). ROIs of images, located above the current image, are hatched (see the chapter Additional recommendations).

If the hatched ROIs from the adjacent images are shown on the current image, you should draw the cutlines precisely (considering terrain features, local brightness, buildings, etc.) on the areas without hatching. But you can continue the cutline "under" the hatched areas schematically, keeping only the overlapping with the adjacent ROI.

During transformation of overlapping ROIs into cutlines the algorithm of "holes" finding between cutlines is working. If such "hole" is found, you get the warning and this area is shown by red hatching on preview image if the option **Fill holes between cutlines** is **ON** (**Service | Preferences** menu command, **General** tab).

You should also take into account that the global orthomosaic area is defined by the DEM created from TINs, built during the PHOTOMOD project processing in **PHOTOMOD Core** (see Project processing User Manual) and used for the orthorectification. Push the ▨ icon to display DEM border.

Push the button (**ROIs editor**) (or click menu command **ROIs | ROI's editor**) to open a panel with the following simple vector editing tools used for creating polygons:

- (duplicated by **Insert** key) - adds ROI (starting ROI creation)
- - removes ROI
- (duplicated by **S** key or double mouse click) - selects ROI
- - unselects ROI
- (duplicated by **Insert** key) - adds new vertex to ROI. In case of selected ROI inserts a vertex "between" two closest ones. In case of creating ROI add a new vertex
- (duplicated by **Delete** key) - deletes selected vertex
- (duplicated by single mouse click) - selects vertex
- - unselects vertex
- To move a vertex, select it and move by mouse button along with pressed **Ctrl** key.

The last group of icons is used to assign to the ROI the following properties:

- - orthorectification area. The default mode: the ROI is included to the mosaic
- - transparent area. Portions from other images that are visible "through" the current one in accordance with the images order defined in the window opened by the **Images order** icon ( )
- - background area. A "hole" in the output mosaic is colored by background color (specified in the **Mosaic | Parameters | Orthoimage** window)
- - area where detailed DEM is used for mosaic creation (see the chapter DEM with variable resolution).

It is convenient to use mouse settings when working with ROI (see the chapter Preferences). For example it is easier to click right or middle mouse button instead of **Insert** key on the keyboard.

For editing and creating of ROI you may use **marker=mouse** mode (which is turned on by **F4** key). At that marker on the screen becomes invisible and all mouse' moves leads automatically to appropriate marker' moves without additional mouse clicks.

For convenient ROI's creation use the commands of context menu (appeared after right mouse click in the image window), which duplicate above mentioned operations with ROI.

When editing cutlines you may select group of cutline's vertices by mouse drag along with pressed **Shift** key, and also move the selected group by mouse along with pressed **Ctrl** key. Press **Esc** key to cancel vertices selection.

In the process of editing ROIs for the scanner projects, in some cases display cutlines from neighbor images possible may become slow. This is due to the considerable computational cost for projects of this type. In such cases, it is possible to enter a mode, in which the recalculation of the cutlines from image to image will be performed only at the request of the operator. In order to achieve this, an option **Auto-update of neighbor cutlines** on the **Windows** tab in **Preferences** window should be turned off. In this mode cutlines are updated manually with the **Update cutlines on neighbor images** button on the toolbar.

5.2.4. Regions of Interest load and save

Import and export of ROIs is carried out via loading and saving respectively to standard PHOTOMOD vector resources, while editing and import/export to external exchange data formats is performed by common means of PHOTOMOD Core.

For loading Regions of Interest, the **ROIs | Load ROIs** menu command is used. When the command is activated, the system brings up the standard dialog window for opening vector resource, followed by the parameters dialog window:
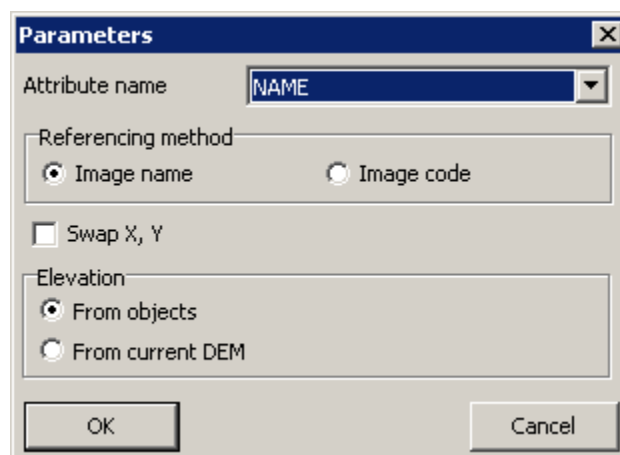
Field **Attribute name** is used for specifying an attribute, values of which for the loaded vector objects correspond to either image name or code. For convenience, the field contains drop-down list with all attribute names found in the resource.
The **Referencing method** option sets the image characteristic used to match region with each image.
The **Swap X,Y** option specifies whether it is necessary to swap X and Y coordinates of vertices during load.
The **Elevation** panel allows selecting the source for the Z coordinate of the loaded regions. ROIs must be converted to pixel coordinates of images, while the vector objects being loaded are given in the coordinate system of the PHOTOMOD project. Thus Z coordinate of each point must be known. If the vector objects being loaded have real Z coordinates assigned, than the option **From objects** should be chosen. Otherwise a correct elevation model has to have been assigned in Mosaic parameters before loading ROIs (a DEM in most cases), and option **From current DEM** should be used in this dialog.

For saving Regions of Interest, the **ROIs | Save ROIs** menu command is used. When the command is activated, the system brings up the parameters dialog window:
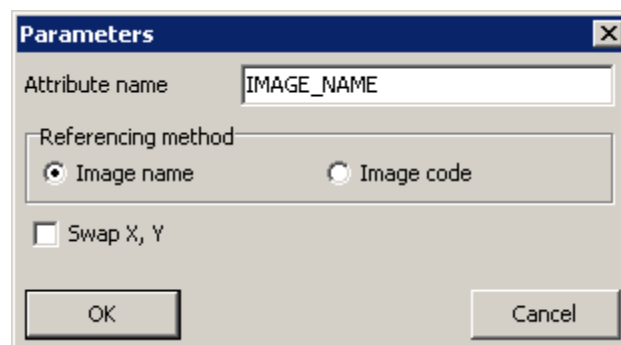
Field **Attribute name** defines name for the attribute holding image reference in the created vector resource.

The **Referencing method** option specifies image characteristic to be saved in the attribute of vector objects.

The **Swap X, Y** option defines specifies whether it is necessary to swap X and Y coordinates of vertices during save.

After the **OK** button is clicked, the standard dialog for selecting vector resource name to save is shown.

For saving cutlines, the **ROIs | Save cutlines** menu command is used. The command is identical to the **Save ROIs** command except that cutlines are saved into vector resource instead of ROIs.

5.3. *Single image window*
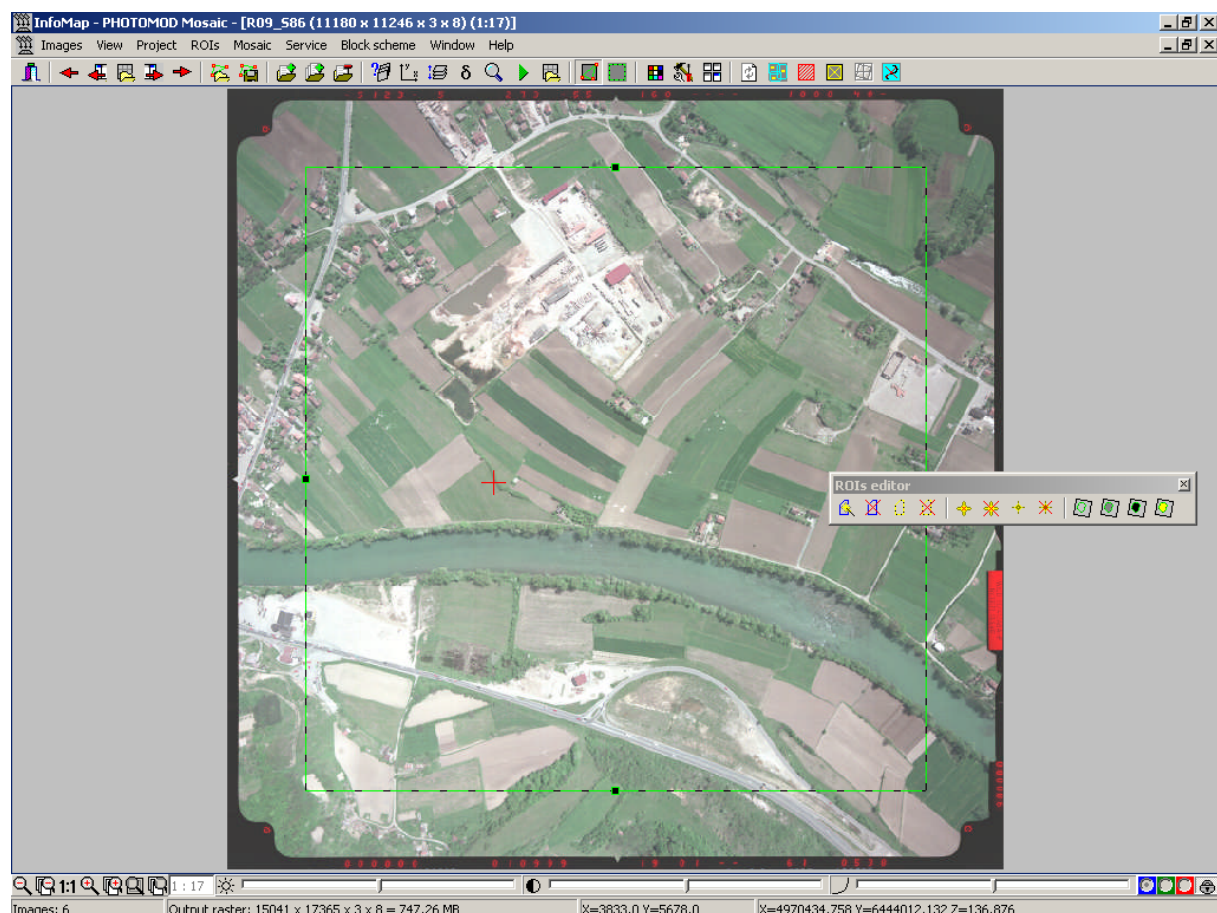
Single image window

At the lower part of the window there are standard icons for displaying raster image:

- ⊖ - one step zooming out (duplicated by "/" key)

- ⊖ - one step zooming out (duplicated by "/" key) for all images opened

- 1:1 - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by "**Alt-1**" keys)

- ⊕ - one step zooming in (duplicated by "*****" key)

- ⊕ - one step zooming in (duplicated by "*****" key) for all images opened

- ⊞ - fitting the whole image into the window (duplicated by "**Alt-Enter**" keys)

- ⊞ - zoom all images to fit in windows (duplicated by "**Shift-Alt-Enter**" keys)

Current image zoom is shown in title bar in brackets after image name and in the lower part of the window as 1 : 49 .

You can also use the following hot keys to zoom arbitrary image fragment or to move it:
- **Ctrl + Alt + mouse**   zooming in by zoom box, "drawn" by mouse
- **Ctrl + Alt + Shift + mouse**   zooming out by zoom box
- **Alt + mouse**   panning the image
- **Mouse wheel**   mouse wheel steering allows to zoom in/zoom out image on the screen

Following sliders (☀, ◑, ⌣), located at the bottom of the window, are used to set up brightness, contrast and gamma respectively for the active image. When working with color images there is a possibility to adjust these radiometric parameters separately by channels (using the buttons ⦿⦿⦿⊕). Right click any slider and select the option **Set original BCG correction** to restore BCG settings by default.

Note. These settings are memorized and used while output mosaic creation

Last 2 icons are intended for ROI creation (see the chapter Creating and editing ROI):

- ⊞ - shows/hides ROI on images. Each cutline and ROI is displayed by different color hatch and labeled by the corresponding image number.

- ▨ - shows/hides DEM to show the entire orthorectification area.

The lower string of image window consists of three parts with information helpful to estimate the following values of resulting mosaic:

6 sheets x 4970 x 4325 x 24 = 379434K   X=5426.0 Y=5209.0   X=4970224.553 Y=6443482.664 Z=155.202

- Number of map sheets of resulting mosaic according to the selected parameters (see the chapter Splitting mosaic into map sheets)
- Raster size of resulting mosaic in pixels (height and width)
- The last multiplier in this section is number of bits per pixel of mosaic to be created. 8 means that resulting image is black and white (8-bit), number 24 shows that the mosaic is color – 24-bit
- Mosaic volume in kilobytes. Shows the mosaic of approximately 94 Mb volume
- XY coordinates of current cursor position on active image in pixel coordinates
- XYZ coordinates of current cursor position on active image in user (terrain) coordinates – you may copy these coordinates to the clipboard (by **Ctrl-C**) and paste them into selected application (by **Ctrl-V**).

5.4. *Using images from other projects*

The images from the other **PHOTOMOD** projects can be used for output mosaic creation. Use the command **Project | Add images from another project** to load them. In the panel opened select the project name, images numbers and push **OK**.

On the figure below you can see an example of mosaic creation using images obtained by different sensors (ASTER and IKONOS) on the same territory and of different spatial resolution and processed in different **PHOTOMOD** system projects.
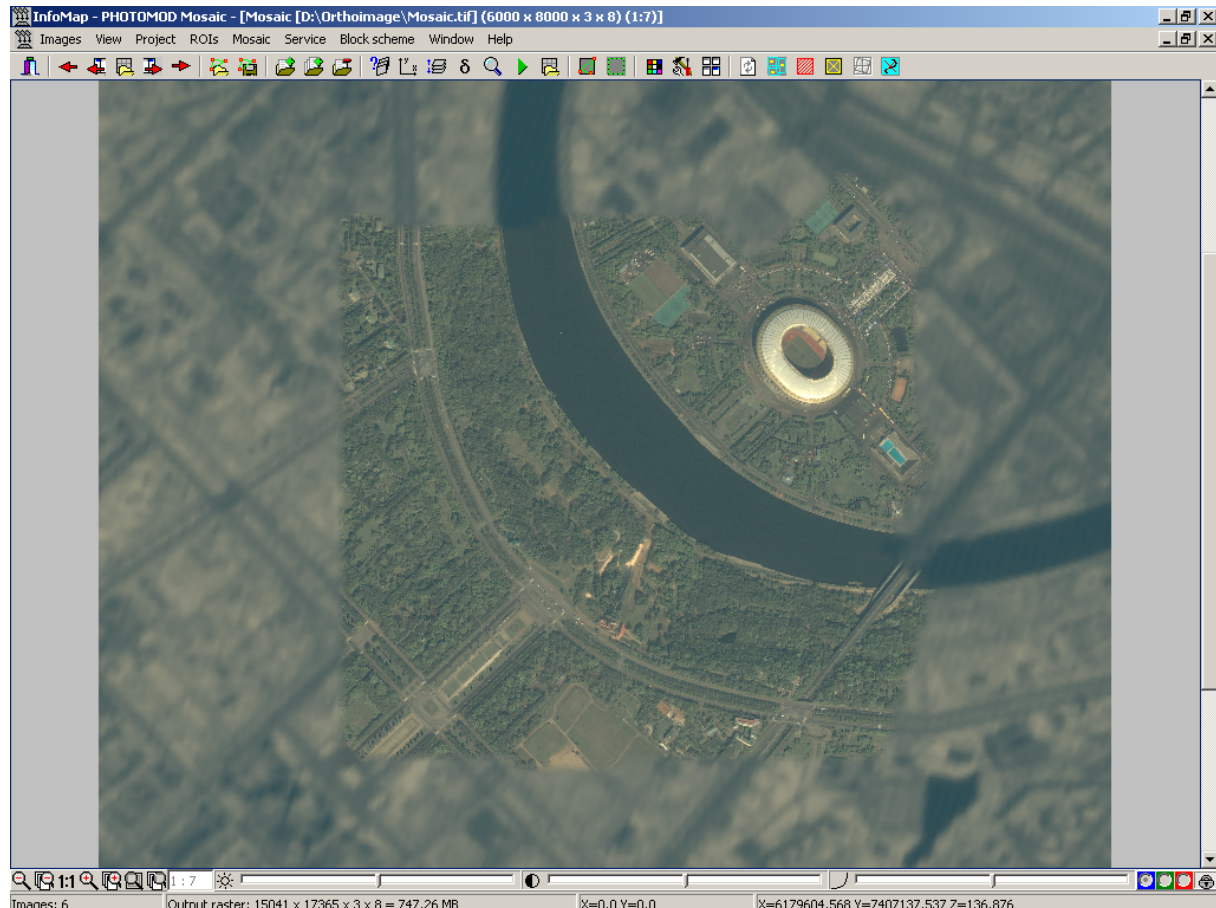
Orthomosaic created from the images taken from different projects

Note. The projects must be referenced to the same coordinate system

6. Parameters and preferences

Use the icon ![icon] or **Mosaic | Parameters** option to open **Parameters** dialog consisting of the following tabs:

6.1. *Type of DTM*

Type of DTM tab allows you to select a type of relief model used for the orthorectification, and also to use breaklines and polygons for mosaic creation.
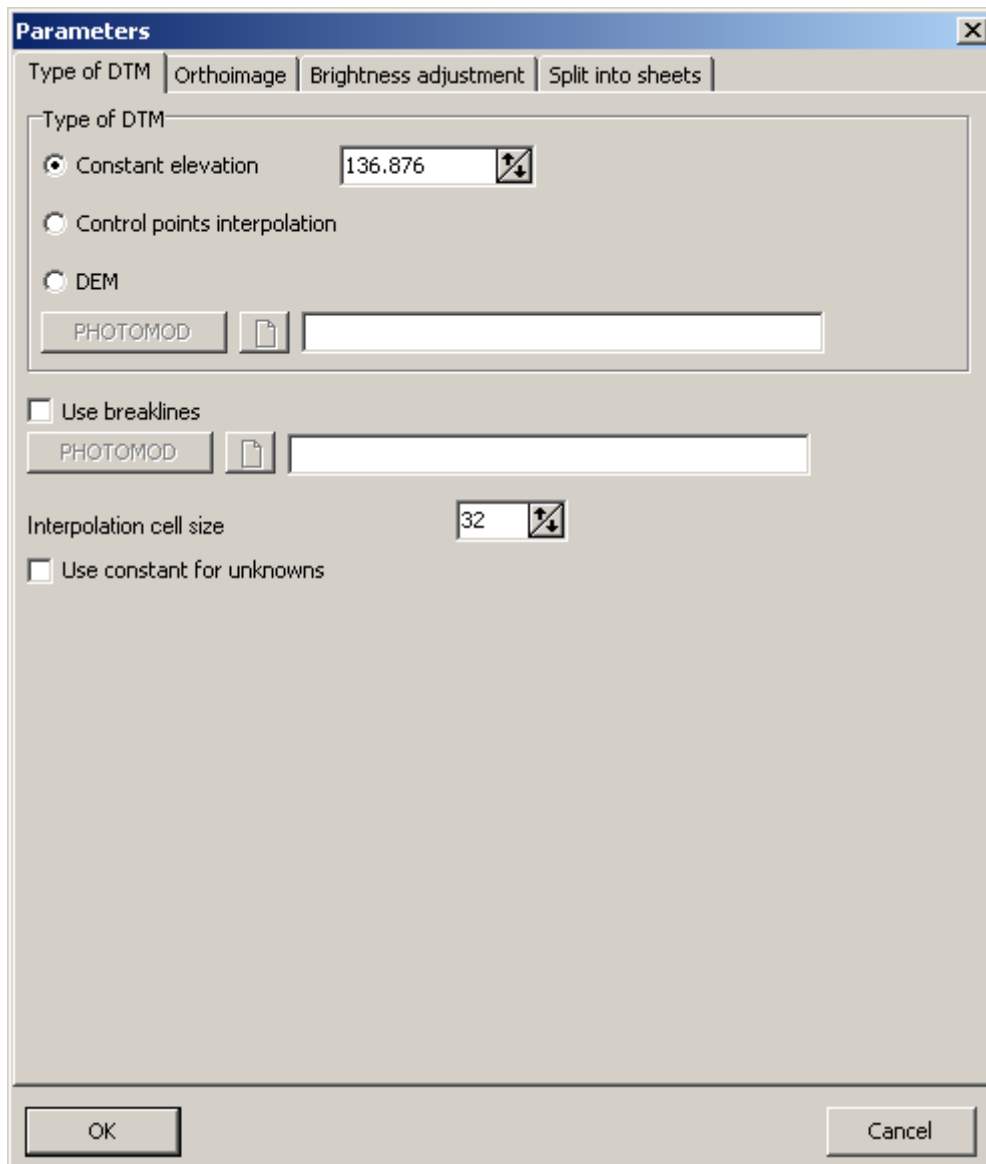
Type of DTM tab

There are 3 possible choices available:

6.1.1. Orthorectification at the constant elevation

In this the same elevation value case is assigned to the whole model area. The surface is approximated by plane. The elevation value is setup in the **Constant elevation** text field. The default is an average elevation value for the area covered by the source block of images, calculated from ties and control points used in the block adjustment.

6.1.2. Control points interpolation

In this case the relief is approximated by a polynomial surface computed by 3D points used during the block adjustment. These points are control, check and tie points (see **Aerial triangulation** and **Block adjustment** User Manuals).

6.1.3. External DEM

Text field **Interpolation cell size** displays a value of the ratio between DEM and the output orthomosaic cell sizes. Thus if the DEM resolution is 2 meters per cell and the mosaic resolution is 0.2 meters per cell, the parameter value is 10. You can increase this value to speed up the orthorectification process. In this case DEM is resampled accordingly, with some reducing of orthorectification accuracy. See also the chapter [DEM with variable resolution](#).

If you setup cell size less than 8 for mosaic projects covering huge territory, it does not increase orthorectification accuracy distinctly, but output orthomosaic will be created much longer. That is why when you try to create a mosaic cell size less than 8 you get a warning message.

Use constant for unknowns parameter allows you to use a value set in the **Constant elevation** for the "holes" (cells with unknown elevation value) in the DEM.

If DEM used for mosaic building consists of several parts you are recommended to turn **ON** the option **Search for DEM fragments** on tab **General** in **Preferences** window (see the chapter [Preferences](#)), to find and load separate DEM fragments.

You can also use vector objects of **PHOTOMOD** system for output mosaic building turning ON the option **Use breaklines**. Push the **PHOTOMOD** button and select necessary resource in opened window.

6.2. *Orthoimage*

The **Orthoimage** tab is used to set up the following parameters:
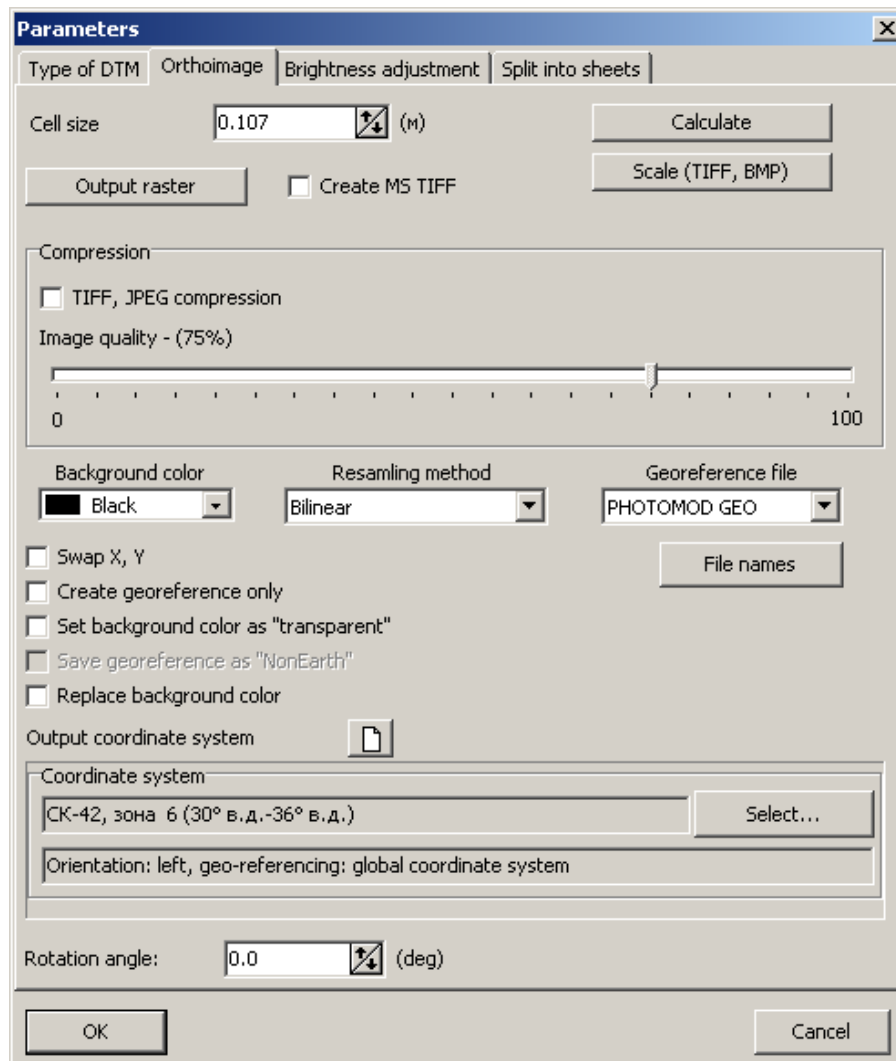
- **Cell size** – this text field is used to enter the size of the orthoimage cell on the ground. This parameter should be specified in units shown in brackets. By default the cell size is equal to the cell size of the first image of mosaic project. The **Calculate** button opens a dialog used to set an orthoimage size in pixels and recalculate its cell size accordingly. The **Scale (TIFF, BMP)** button opens a dialog used to calculate print size and resolution according to the resulting mosaic scale input by the user. **Output raster** button is used to setup the parameters of output raster (see chapter Setting up the channels of the output image).
- **Create MS TIFF** – used to create pyramid image of output mosaic inside TIFF or GeoTIFF file created, that allows to speed up the image zooming.
- Options in the **Output images compression** panel are used to compress the output mosaic image. Check the **JPEG compression of TIFF files** box and use the **Image quality (0-100%)** slider if you want to apply the compression. The default value of compression quality is 75% (usually it causes the 5-7 times compression).
- **Background color** – used to set a color of orthoimage background (since it always inscribes into a rectangular raster). Following options of background color are provided: **Black**, **White**, **Other** (the last one opens standard OS Windows dialog of color selection). In case of grayscale output selected color is replaced by corresponding grayscale value (with the same intensity).
- **Resampling method** – allows to choose brightness interpolation mode for orthomosaic creation: bilinear, cubic and nearest neighbour.

- **Georeference file** – allows to select the format of the additional file created along with output orthomosaic and containing the information for mosaic referencing to coordinate system. See the chapter Georeference file.
- **Swap X,Y** – allows to swap output mosaic coordinates if necessary.
- **Create georeference only** – allows to create just georeference file without building the mosaic. They are saved to the path selected into file format indicated in the **Georeference file** drop-down list
- **Output coordinate system** – allows to change coordinate system of output orthoimage using the window opened by pushing the **Select** button. Work in this window is described in the appropriate chapter of **PHOTOMOD Project creation** User Manual. **Source coordinate system** button turns off the conversion of output orthophoto to another coordinate system using the coordinate system of the PHOTOMOD current project as an output coordinate system.
- **Rotation angle** – allows to rotate output mosaic. It is helpful when initial images block has elongated shape, and you need to cut unnecessary background in rectangle window of resulting mosaic.
- **Set background color as "transparent"** – when saving the resulting mosaic in MapInfo format (selected in **Georeference file** drop-down list), you can set the background color which will be shown in MapInfo system, as transparent.
- **Replace background color** – allows to change color of pixels located inside mosaic image to avoid pixels on orthophoto with the same color as its background.
- **Save georeference as "NonEarth"** – when saving the resulting mosaic in MapInfo format (selected in **Georeference file** drop-down list), allows you to save georeference as NonEarth coordinate system. Used if MapInfo system does not support coordinate system of PHOTOMOD project.

Push the **File names** button to open **Sheets file** window:
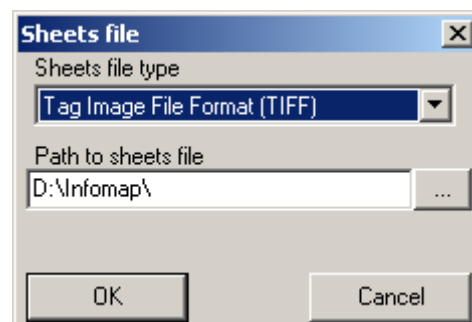
In this window you can edit the file type (its format) and the path to sheet files, where the sheets are stored after orthophoto creation. Files of map sheets have the same format, as the mosaic, which is not divided into sheets, see the chapter Building and viewing orthomosaic.

6.2.1. Setting up the channels of the output image

PHOTOMOD Mosaic is capable of creating output images with arbitrary quantity and order of channels (bands), with 8 or 16 bits per channel sample. The button **Output raster** in the **Orthoimage** tab of **Parameters** window is used to set up the channels. Pressing it brings up the following dialog window:
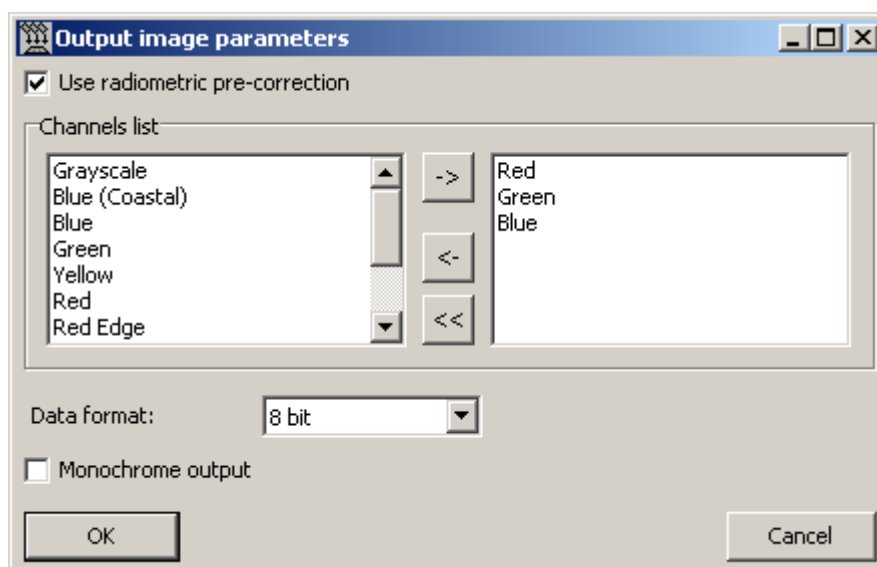
The **Use radiometric pre-correction** option defines whether radiometric correction parameters saved in the PHOTOMOD project should be used for viewing source images and creating orthoimages. When this option is switched, channels configuration in the **Channels list** panel is reset to default state for the given option value.

The **Channels list** panel allows setting number and order of channels in the output orthoimage. The list to the left contains all supported channel types. The list to the right contains chosen channel configuration.

The [->] button adds selected channel from the left list to the right one.

The [<-] button deletes selected channel from the right list.

The [<<] button clears the right list.

The **Data format** dropdown list allows selecting 8 or 16 bps output format.

The **Monochrome output** option controls whether a single channel grayscale image is created, with this single channel formed by averaging values of channels set in the right list of the **Channels list** panel.

Note: When any of the settings is changed in the Output image parameters dialog, the cached local and global brightness adjustment results are reset.

6.3. *Brightness adjustment*

The **Brightness adjustment** panel is used for radiometric correction of source images in order to produce seamless output mosaic.
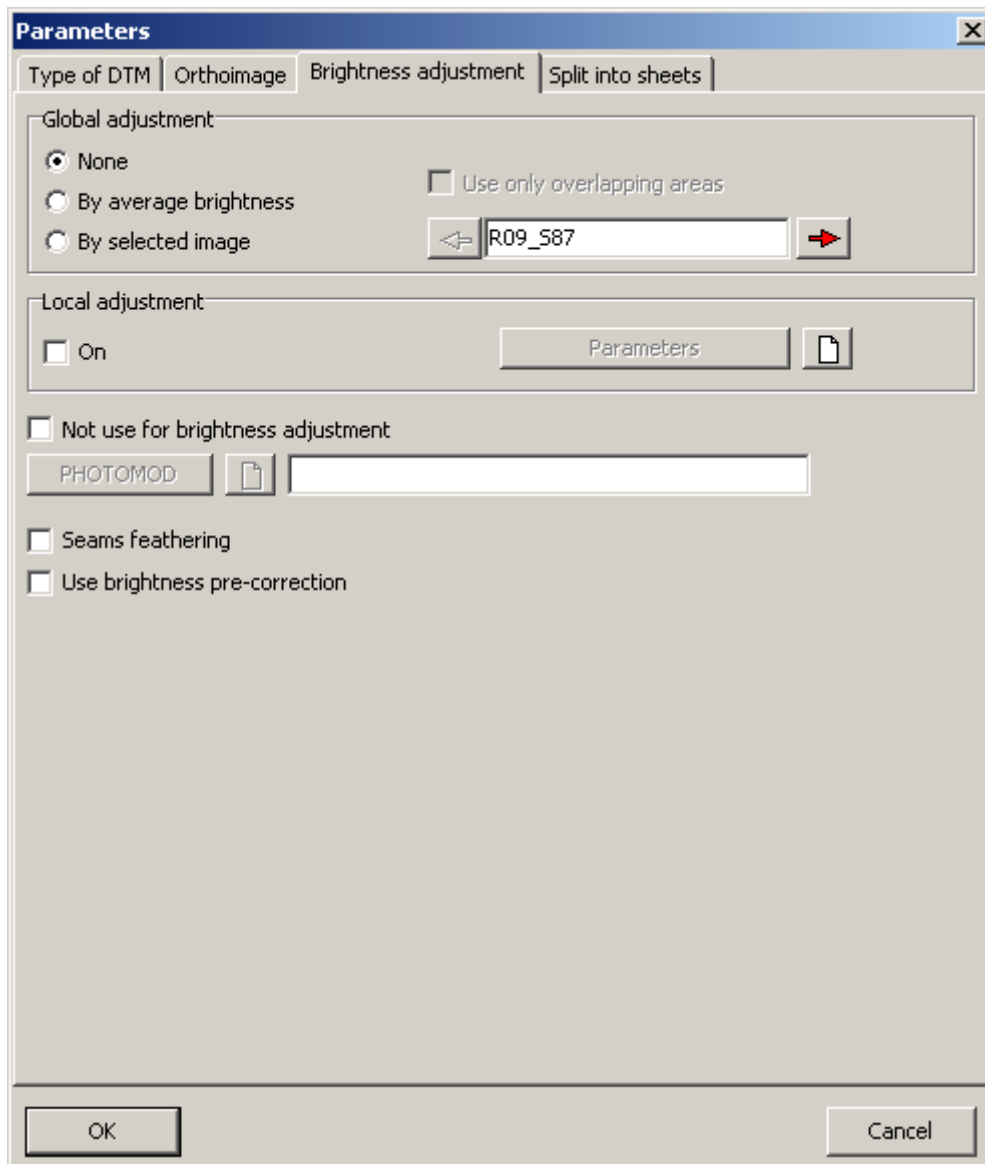
Brightness adjustment parameters

This panel allows you to setup global brightness adjustment of resulting mosaic (see the chapter Global brightness adjustment) and also local adjustment parameters (see the chapter Local brightness adjustment). Moreover, here you can turn on/off the **Seams feathering** option which causes smoothing in the narrow zone around the seam between adjacent images. The size of smoothing zone is defined by the **Interpolation cell size** parameter (see the chapter DTM from TIN).

Use brightness pre-correction option is used to include/exclude brightness-gamma-contrast adjustments done on initial images windows during resulting mosaic creation.

The **Not use for brightness adjustment** option allows ignoring in the process of brightness adjustment of specific areas specified by a set of polygonal vector objects. Such sites may include anomalous brightness areas, for example, clouds, shadows from the clouds, small water surfaces. Using this option in such cases can significantly improve the quality of brightness adjustment.

6.3.1. Global brightness adjustment

The global brightness adjustment (**Global adjustment** panel) applies selected type of transformation to all pixels of every source image.

Following radio-buttons are used to select a brightness adjustment type:

- **None** – allows to use un-adjusted images
- **By average brightness** – brightness and contrast are adjusted basing on average values calculated over all mosaic images. This method is recommended when there are big differences between brightness' of images but each of them contains relatively smooth scenes. Thus in cases of scenes with sharp different brightness within one image (for example the sea and the coast) this method may produce incorrect results.
- **By selected image** – mosaic brightness and contrast are adjusted in accordance with corresponding parameters of selected ("reference") image. Use red arrow buttons for the image selection. The option **Use only overlapping areas** causes using only overlapping image areas for the brightness adjustment. In this case it is recommended to select an image from the middle part of the block as a "reference" one. However in case of abnormal brightness fluctuations ("trends") you can face a problem of smooth increasing or reducing of the brightness from the reference image to the block edges. So it's not a recommended option for such kind of data.
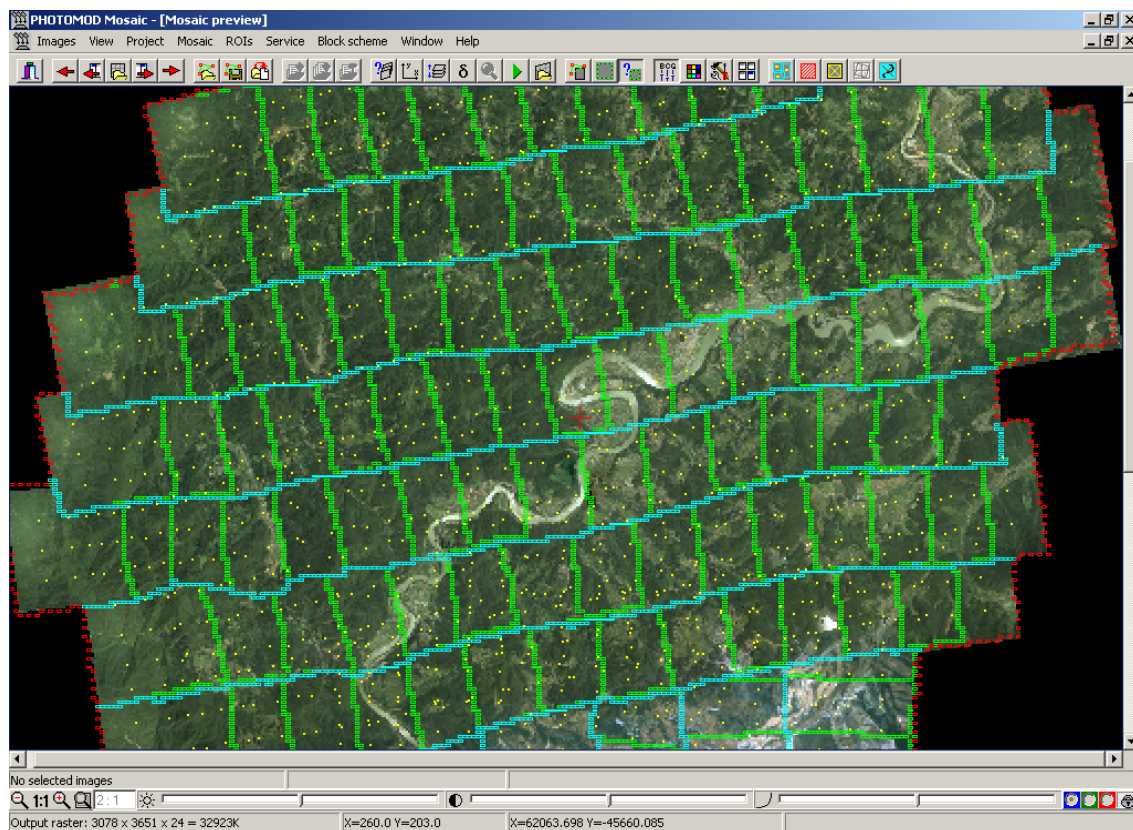
6.3.2. Local brightness adjustment

The local adjustment of image brightness applies some brightness transformation along cutlines of images that are merged into mosaic with a smoothing going down to the image central point and mosaic edges. During this process the brightness (additive component) and contrast (multiplicative component) of initial images are changed at the same time. Use the **Local adjustment** panel on the **Brightness adjustment** tab on the **Parameters** window to setup the process parameters.

There are some suggestions for creating cutlines for local brightness adjustment: it is recommended to draw cutlines along the borders of uniform color objects but at some offset from it to avoid border blurring when using the **Seams feathering** option (see the chapter Brightness adjustment). The offset size should be about one-two **Interpolation cell sizes** (see the chapter DEM types) taking into account the ratio between source images and output orthoimage scales. For example interpolation cell size = 32, source image cell size = 0.17 m and the required orthoimage cell size is 0.5 meters. The ratio between source and output scales is about 3, so you can draw a cutline at distance 3*32 = 100-200 pixels from the object edge.

Sometimes the local adjustment produces bad looking seams or small abnormal brightness or color spots close to seams. You should change the cutline position to resolve the first problem. The color spots can be removed by adding "pins" inside them, while working with the image in **Preview** window. So open **Preview** window and put "pins" inside spot areas using the **Insert** key. The pins are displayed with yellow circles and are selected by mouse click, deselected by **Esc** key and deleted by **Del** key.

Use the option **View | Local adjustment** when **Preview** and **Mosaic** windows are opened to display areas where statistical parameters were calculated. Areas between images of one strip are green, areas between images of separate strips are blue and areas inside single images are yellow. This information would help you to view and understand the reason of local brightness unevenness.

Local brightness adjustment in preview window

Local brightness parameters are adjusting in appropriate window (opened by the **Parameters** button) on two tabs: **Base** – contains parameters influencing on brightness inside images and between them, and **Edges** – contains parameters influencing on brightness of external orthomosaic borders.
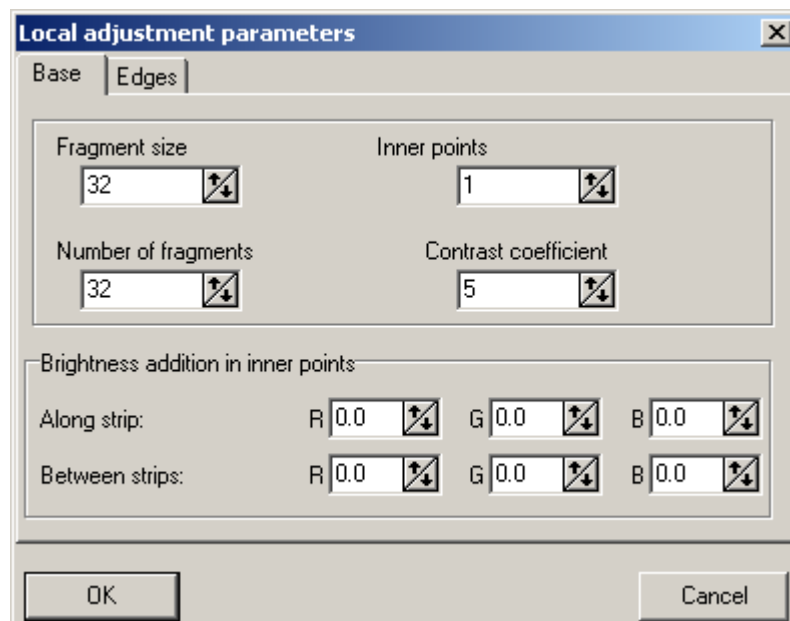
Base parameters

On **Base** tab:

- **Fragment size** − a size of image fragments of the same name, used for creating of model of local brightness adjustment. The bigger fragment size the better adjustment but the slower processing.
- **Number of fragments** − number of fragments of the same name (rectangular regions of the image, containing identical regions of two or more images), located on each image. The greater the number the better adjustment, but the slower the process of parameters calculation and orthomosaic creation.
- **Number of inner points** − sets the number of points inside the image and on the edges of orthomosaic, where the brightness should be preserved. Lack of inner points leads to brightness anomalies when moving away from the cutlines. Excess number of inner points causes the brightness un-adjustment along the cutlines.
- **Contrast coefficient** – in some cases when the contrast of initial images was defined incorrectly it causes poor brightness adjustment or errors in creating of local brightness adjustment model. You can increase the value of this parameter up to 7 to improve the result.
- **Brightness addition in inner points** – allows to setup brightness (separately by R, G, B channels) in inner points either along the strip and/or between the strips. It is recommended to use this parameter in case of considerable brightness change from image center to its sides, which is impossible to remove by another way. At that the **Inner points** parameter should be not more than 1-2.
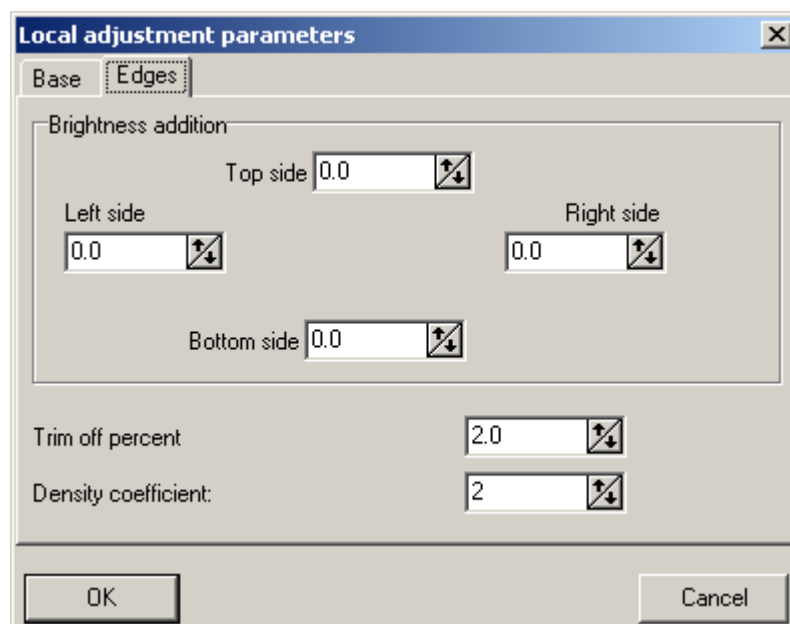
Brightness parameters on mosaic edges

Edges tab contains the following parameters:
- **Brightness addition** − allows to setup smooth brightness change on 4 sides of orthomosaic. Color imbalance on orthoimage sides is unnoticeable, that is why the brightness is changing in all spectral channels at the same time.
- **Trim off percent** – allows to exclude corresponding percent of image area along the orthomosaic sides from processing (because there are auxiliary signs, marks, etc.).
- **Density coefficient** − sets the amount of tie points on the edges of mosaic, which are used for adjustment. Lack of these points leads to brightness anomalies when moving away from the cutlines. Excess number of tie points causes the brightness un-adjustment along the cutlines.

Note. Changing these parameters is recommended just for experienced users

Note. Since local adjustment parameters depend on cut lines location, then any cutlines change results in recalculation of the parameters, when you start mosaic or preview building
Note. It is recommended to exclude from the mosaic each second image in every strip when using local brightness adjustment. Obviously it is necessary to have triple overlap (greater than 50 percent) between images in this case

If you get message **Interpolation model building error** during mosaic creation, it means that local brightness adjustment has been done incorrectly and you should change the **Contrast coefficient** parameter, as described above or correct cutlines.

6.3.3. Additional recommendations

In most cases the local brightness adjustment procedure provides satisfactory results. But if you want the algorithm to work ideally you should draw the cut lines as described below.
The local adjustment works in such a way that images of each strip are adjusted first and on the second step the strips are inter-adjusted. So the best situation is when ROIs borders inside every strip are "continuous" as it is showed on the picture.
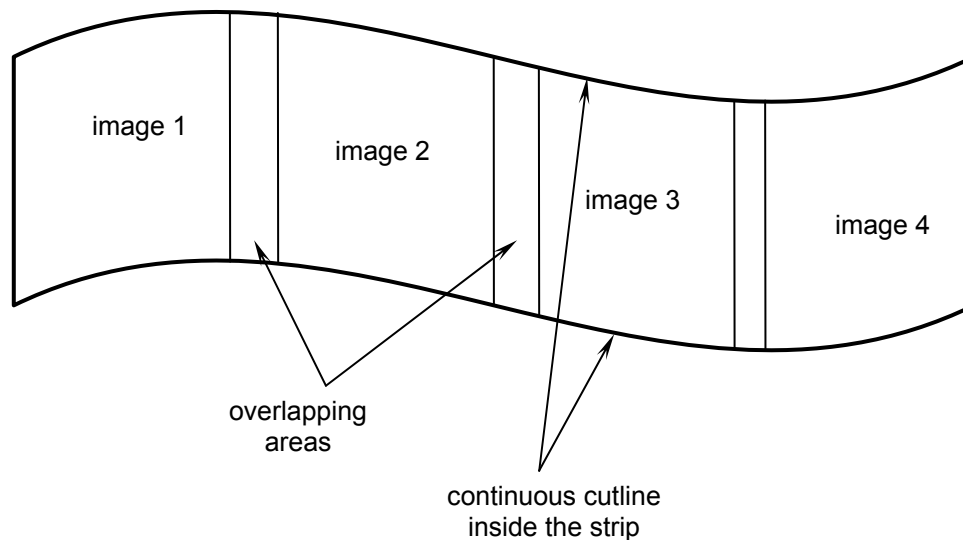
Then the strips are adjusted with some overlapping area:
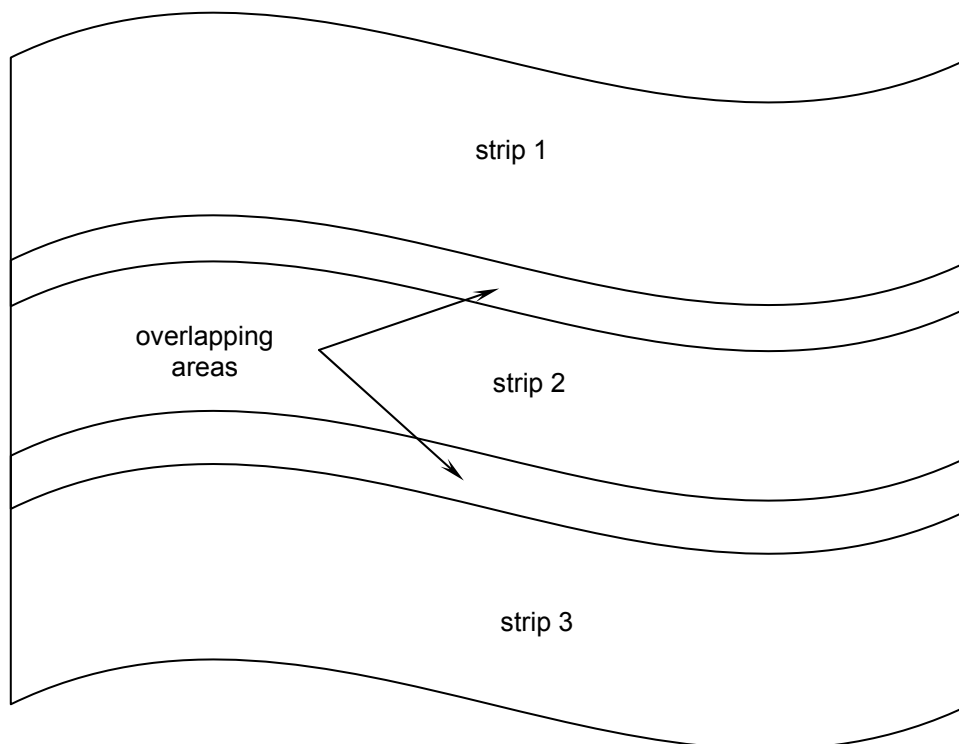
You should pay attention on the order of images insight the strip – because ROIs taken from "upper" image are included to the resulting mosaic and their brightness is considered during brightness adjustment of the orthoimage.

For brightness adjustment of resulting mosaic it is enough to change images order by using menu command **Mosaic | Images order** (or the [icon] icon) which opens **Images order** window.
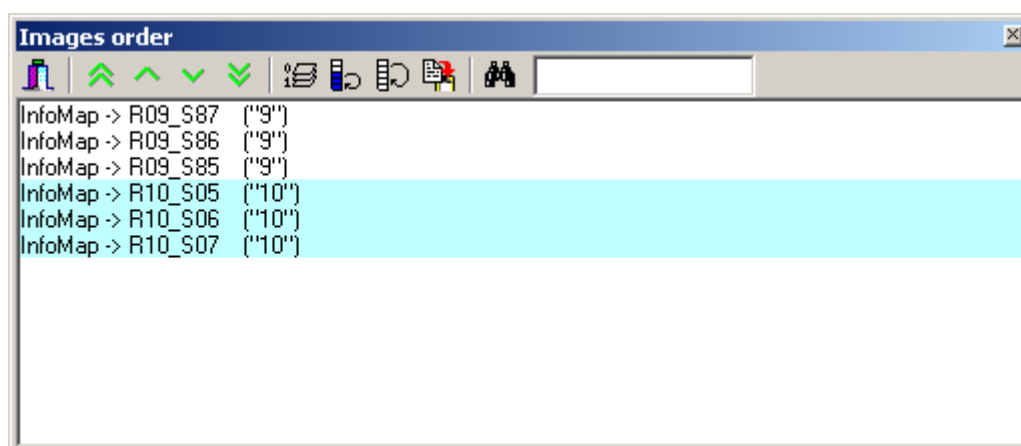
Images order change

The color in this table highlights the images of the same strip. You can move images in the list using icons [icon] - **Upper**, [icon] - **Lower**, [icon] - **To top**, [icon] - **To bottom**, selecting those which will be included in resulting mosaic in overlapping area. It is convenient to use the following operations for work with images list:

[icon] - **by images order** – restore the initial order of the images and cancels all changing.

invert order of selected images – allows to sort selected images in the revert order.

invert order of all images – allows to sort all images in the revert order.

copy to clipboard – copies list of images names into clipboard in text format, allowing to paste them into text editor, send by e-mail, etc.

find – starts image search in the list using its name after name input to search field.

Select image name by mouse click. And group of images is selected with pressed left mouse button along with **Ctrl** and **Shift** keys. You can also move selected names using buttons with arrows in this window, described above.

6.3.3.1. *Tutorial on setting up brightness adjustment in PHOTOMOD Mosaic*

If the final mosaic image contains clearly observed boundaries between areas with different brightness/contrast along some of the cutlines (when the options of local and global brightness adjustment are on) - it is necessary to check whether the local brightness adjustment is active for these cutlines. If not, parameters of the mosaic creation should be tuned.
Example of the problem - the boundary between the SPOT and Formosat images (about one third of the sheet from its left side):
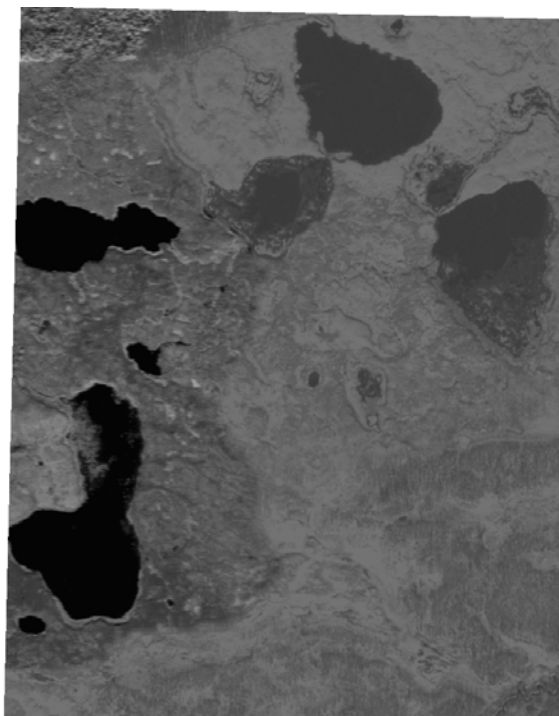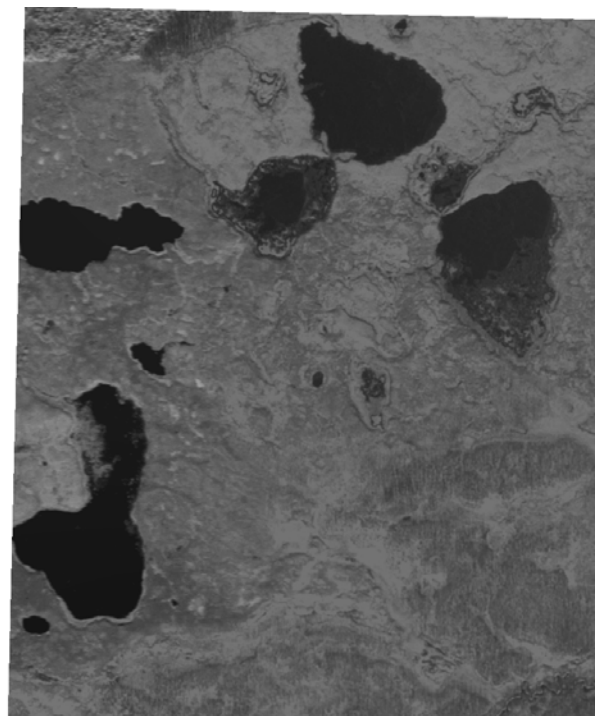
The local brightness adjustment is active   The local brightness adjustment is not active

To find the cutlines, along which the local brightness adjustment has not activated, it is necessary to turn on the display of adjustment areas on the mosaic preview (local brightness adjustment must be activated in the parameters of the mosaic creation) - menu command View | Local brightness adjustment. After this, the preview takes the following view:

The problem area is outlined by the red ellipse the resulting mosaic fragment is shown
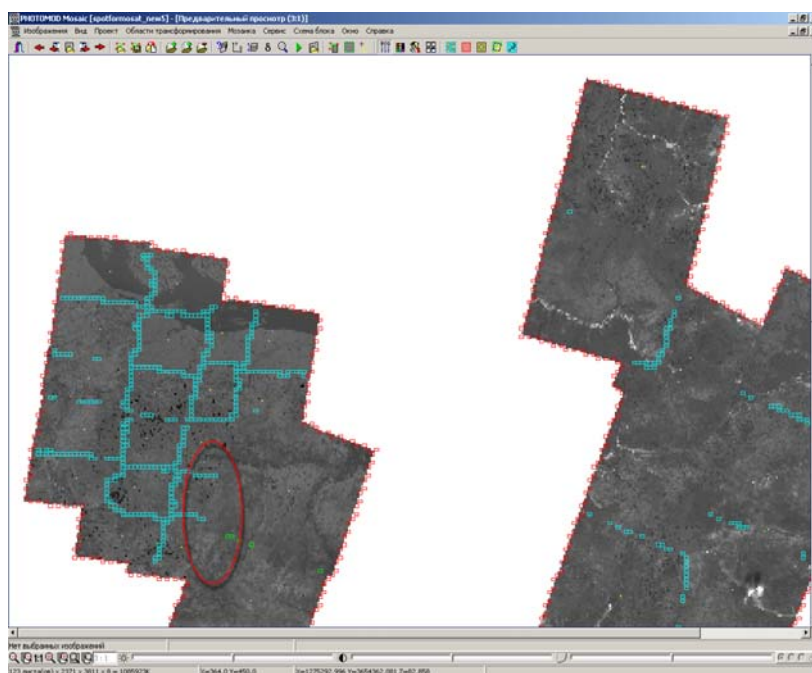
Mosaic preview. The local brightness adjustment is not active.

If the local brightness adjustment is not active, a warning message is displayed.
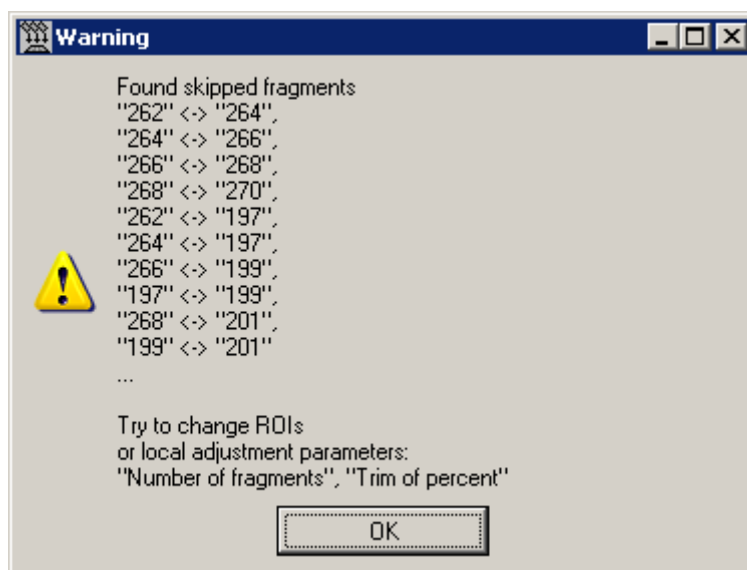
The problem area is outlined by the red ellipse in the resulting mosaic fragment shown
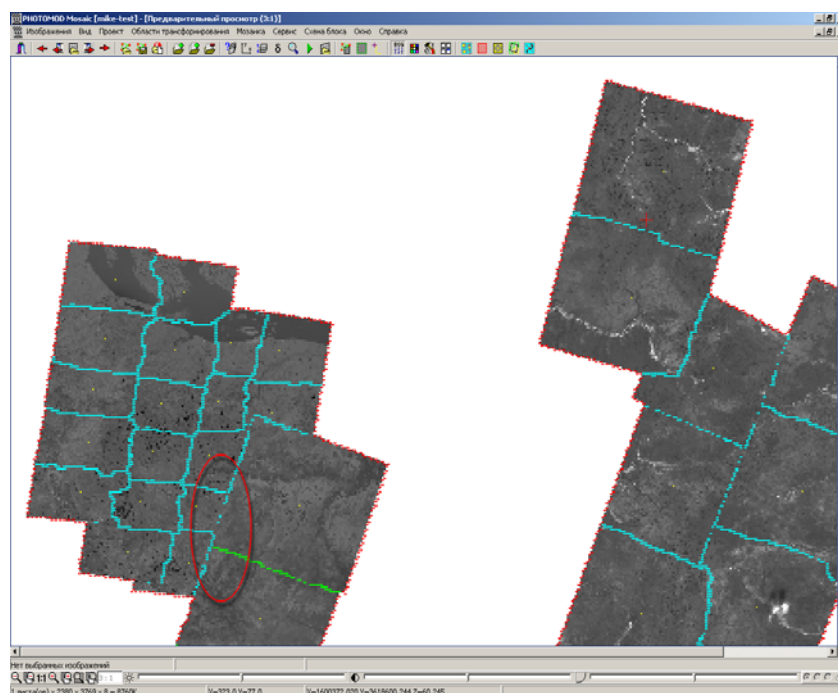
Mosaic preview. The local brightness adjustment is active.

Red squares correspond to areas of fixed brightness along the edges. Gree and cyan squares correspond to adjustments ares inside and between nominal mosaic strips. If the images overlap area having brightness adjustment problems, lacks green or cyan squares, the local adjustment there has not activated. Local adjustment settings should be tuned in order to resolve the problem, using **Mosaic | Parameters | Brightness adjustment | Parameters** command.

Settings on the **Local adjustment parameters | Base** tab:
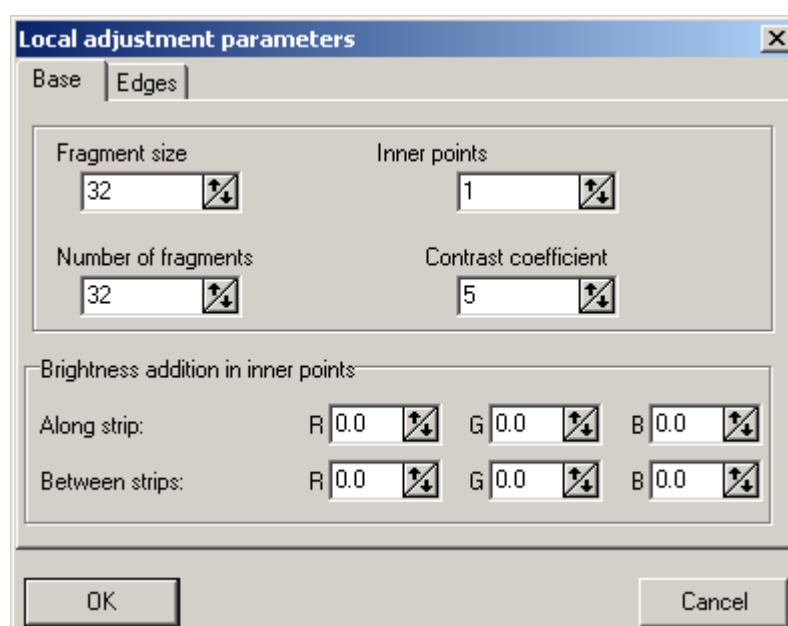
Basic local adjustment parameters

One should verify that Contrast **coefficient** field is set to 1, except when it should be changed for some other reasons (e.g. when some abnormal brightness or color defects appear on images outside overlapping areas).

Increase the **Number of fragments** value (set to twice the initial value for the first time, then increase more depending on the influence of the changes on the result). On screenshots with local adjustment not activated, it is the result of number of fragments set to 32; on screenshots with local adjustment activated successfully - this number had been set to 64.

Settings on the **Local adjustment parameters | Edges** tab:

Local adjustment parameters on edges

For satellite images, **Trim off percent** should be set to 0.

Generic workflow should be as follows: before creating output mosaic, check if local adjustment has activated as described, then choose a pair 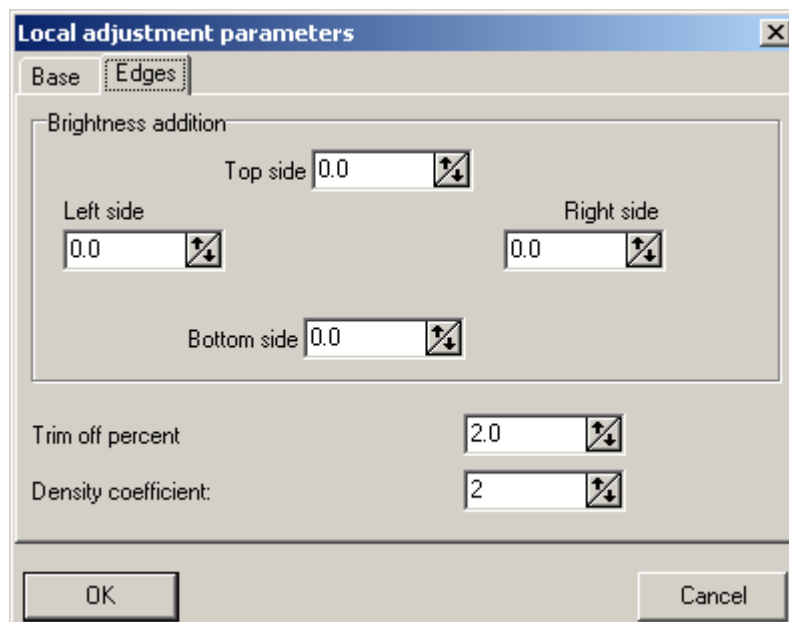of images with different radiometric characteristics and create a sample mosaic covering only their overlapping area, in order to make sure the adjustment works correctly.

There is no need making all the overlapping area covered by the squares. It is enough to have several for each overlap; further increase of the quantity of the squares does not lead to any noticeable quality increase.

6.4. *Splitting into sheets*

Process of output mosaic splitting into map sheets is described in details in the chapter Splitting mosaic into map sheets.

6.5. *Preferences*

The **Preferences** window opens by the icon of the main button bar or the menu command **Service | Preferences**.
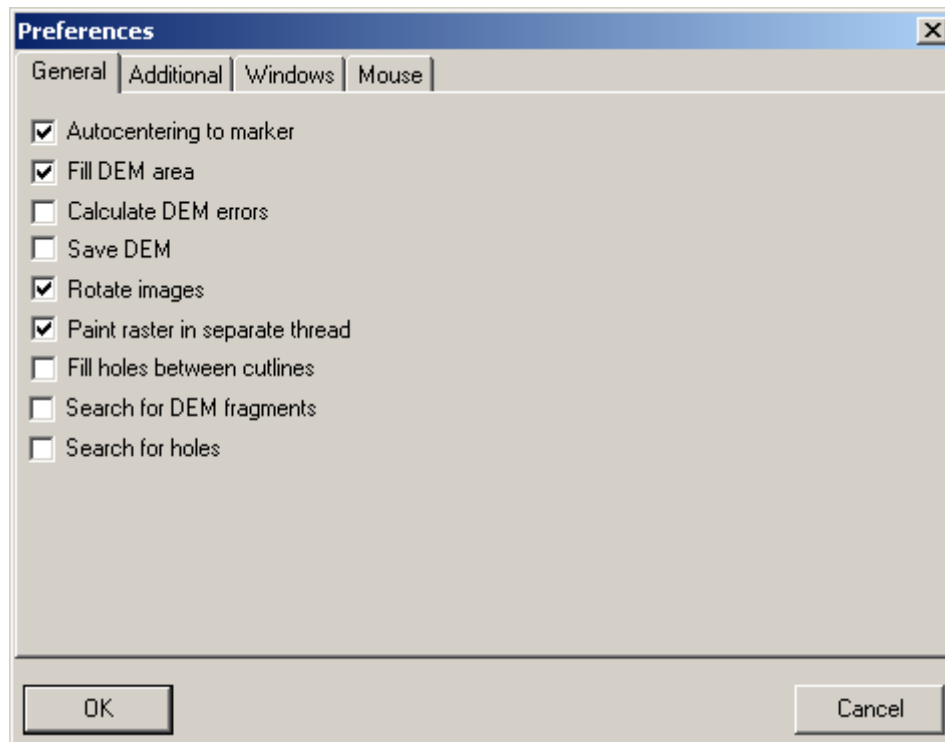
PHOTOMOD Mosaic preferences are located on the following tabs:

General:
- **Autocentering to marker** – automatically centers window into marker position on the image after image zoom in/out
- **Fill DEM area** – shows DTM area as dashed polygon. If this option is off just DTM border is displayed.
- **Calculate DEM errors** – is used for calculating errors of DEM created while the orthorectification. The errors are differences between source TIN nodes and corresponding DEM cells in Z coordinate. After DEM creation appears a window, which displays Maximum error, Average error and RMS. Decreasing a value of the **Interpolation cell size** parameter (see the chapter Type of DTM) reduces the errors, since in this case the DEM "describes" a source TIN more precisely.
- **Save DEM** – allows to save the DEM created during orthorectification in Surfer ASCII grid format (with grd extension) in the same folder and the same name as orthoimage. The DEM has the same parameters as the orthoimage (resolution, sampling, etc.).
- **Rotate images** – turns off/on the using of rotation and flipping parameters pre-set in **PHOTOMOD Core** module for source images preview.
- **Paint raster in separate thread** – allows to output ortho-mosaic in separate thread. The visualization after that is smoother but slower, with pre-loading of white background, that is not convenient for panning. It is recommended to use the option for viewing the rasters with large volume or from slow media (CD, network).
- **Fill holes between cutlines** – if this option is **ON** then empty areas ("holes") between ROIs created during cutlines drawing are hatched by red color. (See also the chapter Creating and editing Regions of Interest).
- **Search for DEM fragments** – when loading DEM used for mosaic building (see the chapter External DEM), turn this option **ON** to find and load separate DEM fragments, if the initial DEM consists of several parts
- When convertion ROIs into cutlines, the **Search for holes** option allows to track discrepancies between the cutlines and to issue a warning message.

Windows:
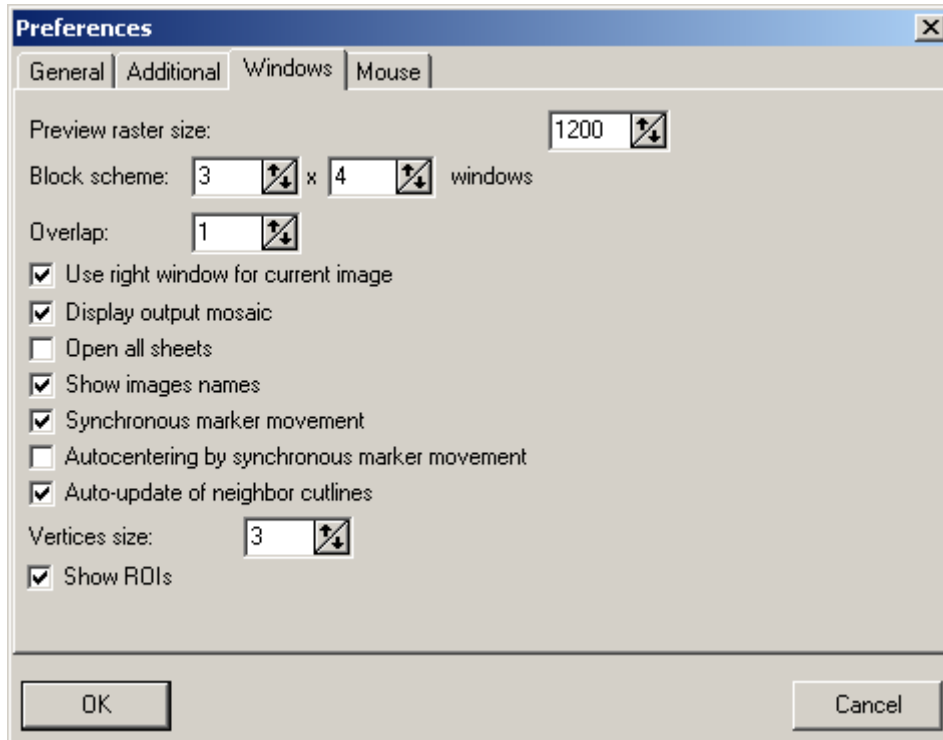
- **Preview raster size** – allows to select maximum raster size (by lines or columns) in Preview window (the default value is 600). Increasing the parameter value improves raster quality but slows down the Preview building.
- **Block scheme** – allows to select number of strips and images included to the block scheme (see the chapter Block scheme). For example if this parameter is 3 x 4 the block scheme consists of 3 strips by 4 images. The **Overlap** parameter is used to set up number of overlapping images in adjacent portions of the block scheme.
- **Use right window for current image** – sets an order of images in block scheme when previous image in the strip is located to the left from the next image
- **Display output mosaic** – opens window with resulting orthomosaic after its building
- **Open all sheets** – if this option is OFF and you are building the mosaic splitted into sheets, the only one of sheets is opened, and other ones you can view using the icons of upper button bar (⬅, ➡). If the option is ON you will get all sheets opened in separate windows.
- **Show images names** – turns off/on images names in images windows and also in preview and resulting mosaic.
- **Synchronous marker movement** – while working with block scheme window the marker will move synchronously on adjacent images, which overlap with the current one. The option is ON by default and is saved not with project but with the mosaic. Use **X** key to turn on the option in image window.
- **Autocentering by synchronous marker movement** – if synchronous marker movement is **ON** (see previous option), the adjacent image is moved when marker moves on the first image to center the window into marker position.
- During editing ROIs on scanner projects, in some cases displaying cutlines from adjacent images can be slow. This is due to large computational overhead for projects of this type. In such cases it is possible to set a mode in which updating of cutlines from adjacent images is executed only by command of the operator. To achieve this, disable the **Auto-update of neighbor cutlines** option in the **Preferences** window on **Window** tab.
- **Vertices siz**e - allows selecting the vertices size of ROIs in the preview window.

- The **Show ROIs** option enables display of ROIs.

The **Additional** tab of **Preferences** window is used to setup the parameter **Cell size decimal places**, which allows to input decimal places amount, used for mosaic pixel size calculating.
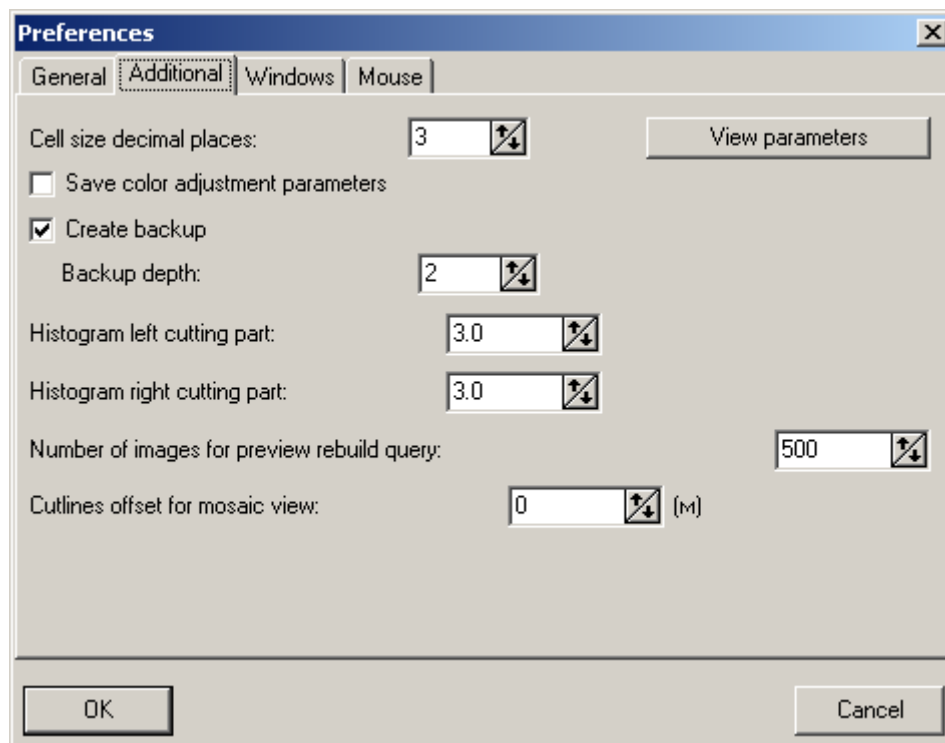
Preferences of mosaic's additional

The **View parameters** button opens a dialog for setting view parameters of the output orthophotos (see chapter Setting up the channels of the output image).

The option **Save color adjustment parameters** is used when the project contains a big number of images. In this case brightness adjustment parameters, selected on the corresponding tabbed page (see the chapter Brightness adjustment), are stored in file of the mosaic project. It allows to open a preview image more quickly when open the project for the next time.

Create backup – the option allows to create a backup copy of a resource when saving a mosaic project into PHOTOMOD resource. It allows to restore the project when needed. You can setup number of backups to be saved in the **Backup depth** field.

Use the window called by menu command **Project | Open** to open project's backup copy. If resources with backup copies are invisible, open context menu in the right list of resources using right mouse click, and mark the option **Show hidden resources**. Then select the **Backup** folder in the left list of resources, and select backup copy in the right list. After that click **OK** and the project will be restored.

The **Histogram left cutting part** and **Histogram right cutting part** options define the part of histogram which is not taken into consideration during calculation of the global brightness adjustment parameters. These options allow properly adjusting images which contain anomalous light and dark objects, such as clouds.

The **Number of images for preview rebuild query** option defines the minimum number of images in a project when PHOTOMOD Mosaic starts requesting confirmation for creatin the preview.

The **Cutlines offset for mosaic view** option determines the indentation (in units of output CS) of painting cutlines polygons on both sides of the actual cutline in mosaic viewing window, which increases the convenience of visual controlling cutlines.

The **Mouse** tab is used to assign operations for mouse buttons (such as duplicating of **Insert**, **Enter**, **S** and other keys). These settings allow to simplify cutlines creation.

6.5.1. Settings composition of channels for viewing orthoimages

In many cases viewing orthoimages requires changing types and order of channels corresponding to red, green and blue colors. This task is solved with button **View parameters** situated in the **Additional** tab of the **Preferences** dialog. Pressing it results in the following dialog window:
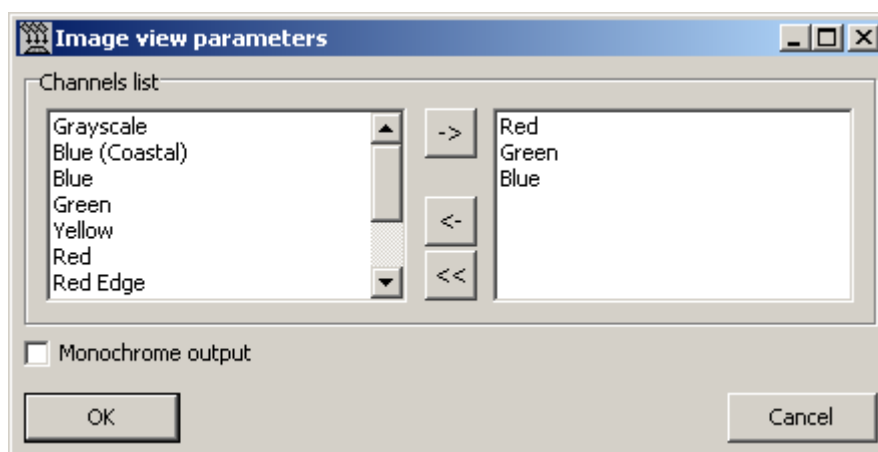
The **Channels list** panel allows setting number and order of channels for viewing images. The list to the left contains all supported channel types. The list to the right contains channel types corresponding to red, green and blue displayed channels respectively.

The [->] button adds selected channel from the left list to the right one.

The [<-] button deletes selected channel from the right list.

The [<<] button clears the right list.

The **Monochrome output** option controls whether a single channel grayscale image is displayed, with this single channel formed by averaging values of channels set in the right list of the **Channels list** panel.

7. Import of PHOTOMOD Mosaic project

In order to provide separate work of several operators when creating ROI's you may use import of PHOTOMOD Mosaic projects.

If, for instance, several operators are working on separate projects and are creating their own part of ROI's. Then these separate projects could be imported one after another into *basic*

project of PHOTOMOD Mosaic. At that ROI's are joined together in this project, which is used for creating of orthomosaic afterward.

Select menu command **Project | Import** to open a window for indicating of PHOTOMOD Mosaic project containing ROI to be imported. After that the window of the following import settings is opened:
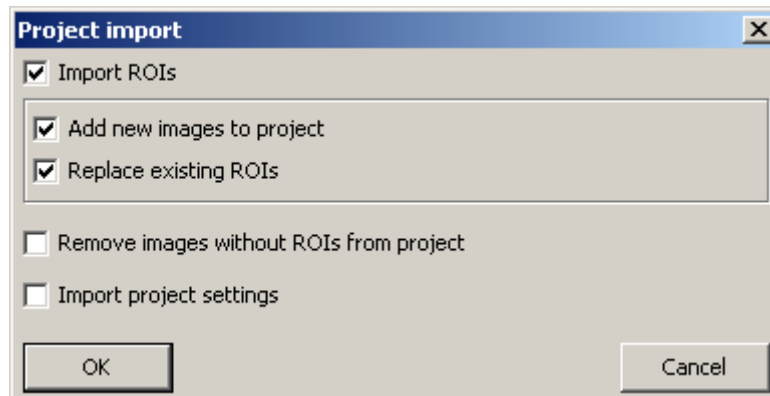
Parameters of project import

Import ROI's – turns on/off import of ROI's from *imported project*. If the option is off the options **Add new images to project**, **Replace existing ROI's** are unavailable.

Add new images to project – allows to add images to current project that are not existing in it, if there are ROI's to be imported.

Replace existing ROI's – allows to replace ROI's of current project by imported ones.

Remove images without ROI's from project – allows to remove all images without ROI's (images with trimmed edges) from project after import.

Import project settings – allows to import all settings of imported project, like DEM, brightness adjustment settings, etc.

Note: if you need to preserve the order of ROI's of imported project you should create the project (or save it at least once) in PHOTOMOD Mosaic version, containing this kind of projects' import

8. Mosaic preview

Once all necessary parameters are set, select menu command **Mosaic | Preview** or push the icon to see a mosaic preview. In this case orthomosaic is built in fast mode with low accuracy. It is convenient to use a preview mode for example to estimate the results of mosaic color adjustment.
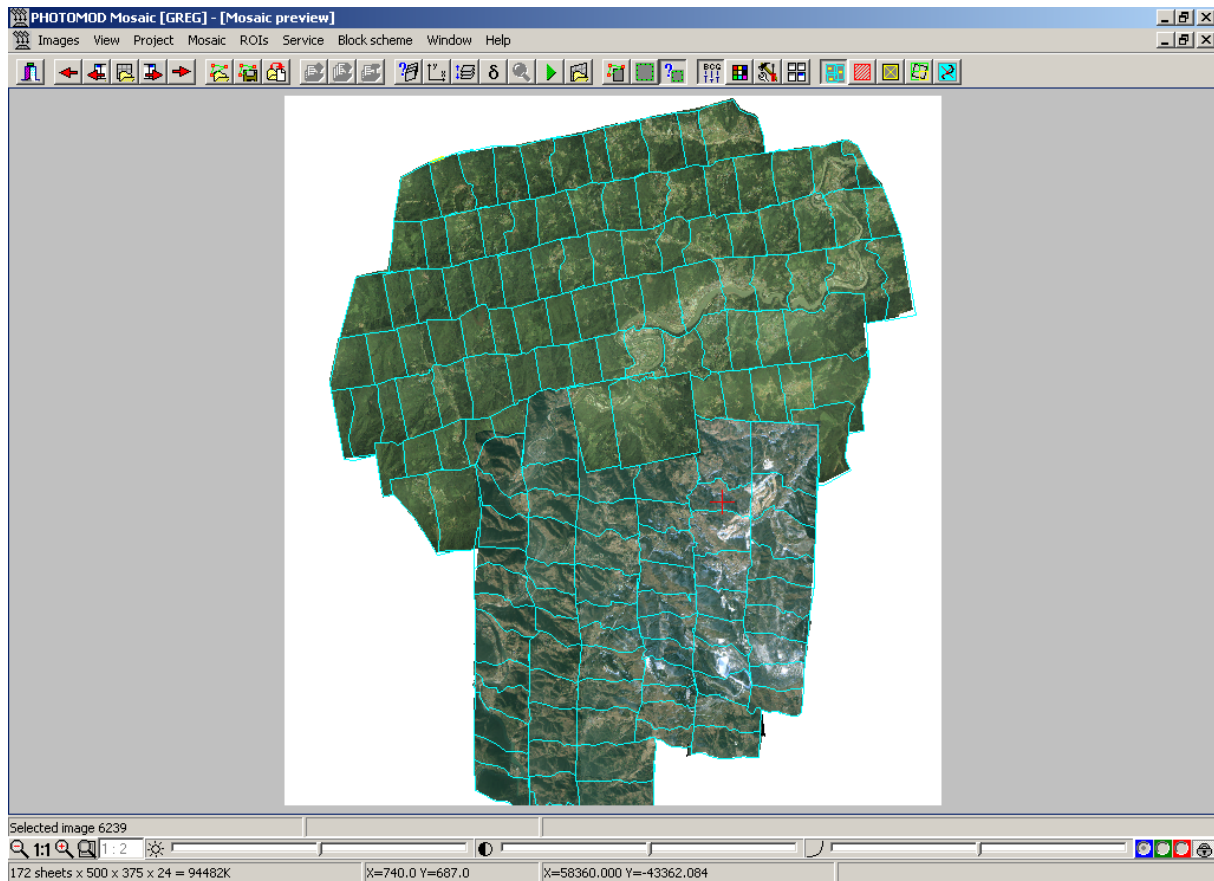
Orthomosaic preview window

At the lower left part of Preview window there are standard icons for displaying raster image:

- - one step zooming out (duplicated by "*/*" key)

- - one step zooming out (duplicated by "*/*" key) for all images opened

- **1:1** - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by "**Alt-1**" keys)

- - one step zooming in (duplicated by "*****" key)

- - one step zooming in (duplicated by "*****" key) for all images opened

- - fitting the whole image into the window (duplicated by "**Alt-Enter**" keys)

- - zoom all images to fit in windows (duplicated by "**Shift-Alt-Enter**" keys)

Current image zoom is shown in title bar in brackets after image name and in the lower part of the window as [1 : 49].

You can also use the following key combinations to zoom or move arbitrary image fragment:
- **Ctrl + Alt + mouse**   zooming in by zoom box, "drawn" by mouse
- **Ctrl + Alt + Shift + mouse**   zooming out by zoom box
- **Alt + mouse**   panning the image
- **Mouse wheel**   mouse wheel steering allows to zoom in/zoom out image on the screen

Following sliders (, ,), located at the bottom of the window, are used to set up brightness, contrast and gamma respectively for the active image. When working with color images there is a possibility to adjust these radiometric parameters separately by channels

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(using the buttons). Right click any slider and select the option **Set original BCG correction** to restore BCG settings by default.

Note. Current coordinates of marker on the preview image (in project coordinate system) are shown in the rightmost field of Status panel. You can copy them to clipboard (by Ctrl-C) and paste afterward into chosen application (by Ctrl-V)

If you need to setup brightness of one image included to the mosaic select it by click inside the corresponding ROI (ROIs are displayed by pushing the icon). In this case all BCG settings will affect only the selected image.

Note. These settings are memorized and used for output mosaic creation

In the preview window the following main menu icons are used:

- - opens/hides a window for specifying the **Images order** for including fragments of sources images into output mosaic in the overlapping area, see the chapter Additional recommendations

- - shows/hides regions of interest in preview and output mosaic windows

- - shows/hides sheet borders if output mosaic is divided into map sheets (the appropriate option is **ON** in **Splitting into sheets** tab of **Parameters** window, see the chapter Splitting mosaic into map sheets)

- - shows/hides DTM area

- - shows/hides triangulation points. If you start precision control operation (**Mosaic | Accuracy control** command or the icon , see the chapter Orthorectification accuracy control) you can select a point in the list and it will be also selected on the image.

Select a rectangular area in the Preview window to orthorectify only a corresponding portion of the source block of images. Use mouse move along with pressed **Shift** key to draw a rectangle on the image. The polygon can be resized by dragging special marks on its sides or moved by dragging. See also the chapter Building orthomosaic for the block fragment.

9. Splitting mosaic into map sheets

Output mosaic could be divided into map sheets. Use the tab **Mosaic | Parameters | Split into sheets** to specify splitting parameters.
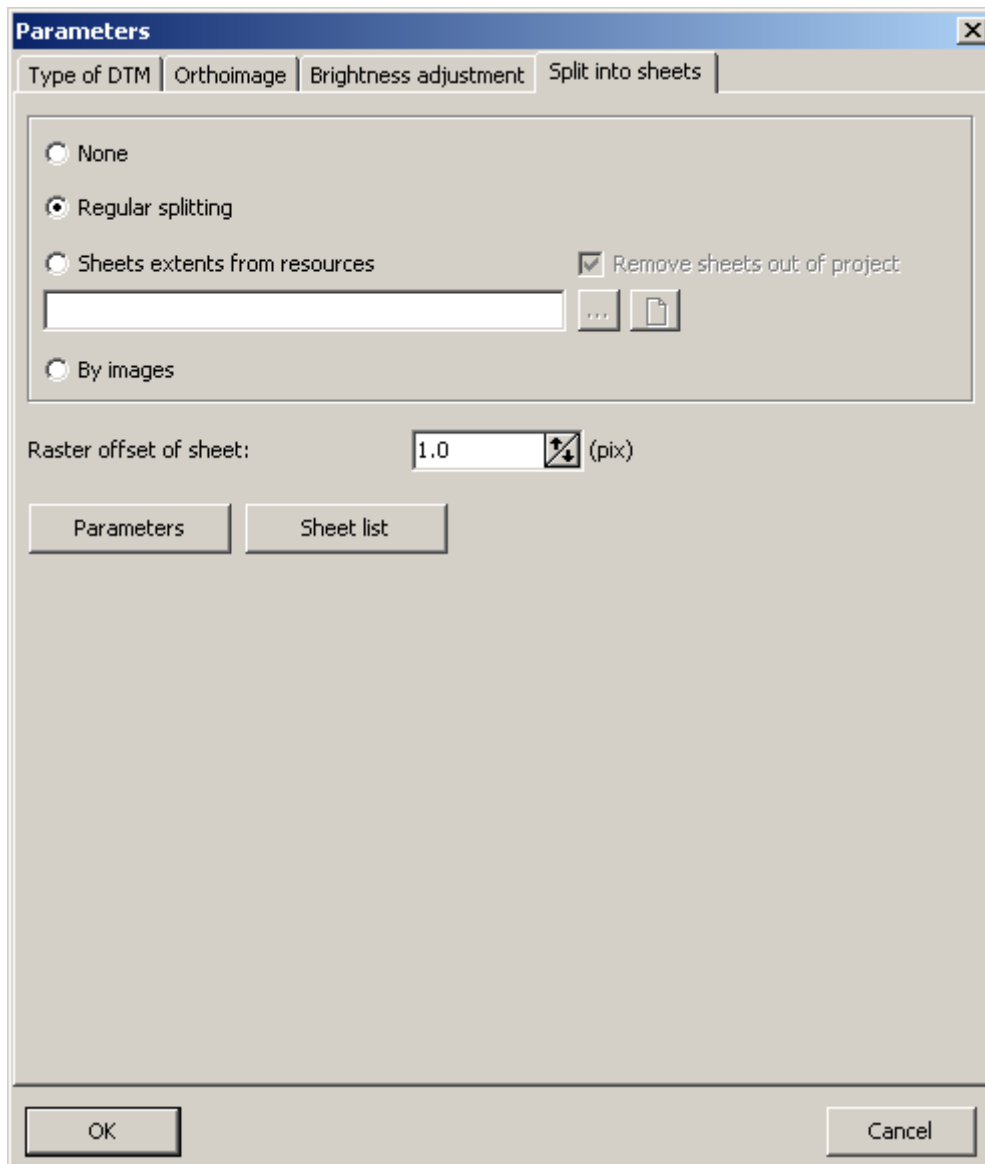
Use the following ways to split output mosaic into sheets:

- **Regular splitting** – select the option **Regular splitting** and specify splitting parameters, see the chapter Splitting parameters. At that the whole orthoimage is divided into sequential map sheets according to the parameters selected.

- **Sheets extents from resources** select the **Sheets extents from resources** option to load sheet borders from **PHOTOMOD** system resources (with the button [...]) from current all any other project. The [ ] (**Clear**) button cancels the selection of sheets. See the chapter Load sheet coordinates from the text file.

- **By images** – borders of images are used as borders of orthophoto sheets, if the option **By images** is selected. At that each initial image of mosaic project is considered as map sheet. Since each sheet contains the only image, the whole process could be considered as batch orthorectification of separate images. Orthophotos for each sheet are created in appropriate regions of interest on their images. Sheet names are defined as initial images names in PHOTOMOD project (and they could be changed if necessary). Sheets management (turn ON/OFF, rename) is the same as for **Regular** sheets splitting, see the chapter Splitting parameters.

If the check box **Remove sheets out of project** is marked (by default) the map sheets on the image area which is out of project territory will be not created. If it is necessary to import

and show all sheets irrespective of their location on mosaic project, clear the check box and re-build the preview to see where the sheets are located.

You can also exclude sheets manually on preview image as described in the chapter Splitting preview.

The **Raster offset of sheet parameter** parameter defines the size in pixels of raster overshoot beyond the sheet frame. Such overshoot may be necessary to prevent appearing of blank areas between sheets of complex geometric shapes, as well as in case the size of a rectangular sheet is not a multiple of orthophoto pixel size.

The **Parameters** and **Sheet list** buttons open the corresponding dialogues (see chapter Splitting parameters).

9.1. *Splitting parameters*

If you split the mosaic into **Regular sheets** or **By images**, specify the parameters of splitting in the window opened by the button **Parameters** from the tab **Mosaic | Parameters | Splitting into sheets**.

To change the extents of the orthomosaic enter new coordinate values of output orthoimage corners in **West**, **South** text fields. Sizes of map sheets are defined in **Width** and **Height** text fields in meters on the terrain. As a result number of sheets by X and Y axes are displayed in **Number of sheets / Horizontally** and **Number of sheets / Vertically** text fields. You can also set overlapping areas of adjacent sheets in meters (**Overlap (m) / Horizontally** and **Overlap (m) / Vertically**).

If the **Trim off "null" edges** option is on the size of uppermost and rightmost sheets are changed to cut them off by the mosaic border. In this case number of sheets is calculated automatically and can not be edited. If this option is off all sheets are of the same size (defined by **Width** and **Height** parameters) and the **North** and **East** coordinates are calculated automatically and can not be edited.

In **Sheets base name** field you should input "root" name of mosaic sheets (**Sheet** by default). At that full file name of the sheet is formed as follows: <Base name (5 characters)>_<literal number of the sheet along the South-North direction (A, B, …, Z)>_<numerical number of the sheet along the West-East direction (1,2,3,…) >.<file extension according to the selected file type>.
See also the chapter Sheet file names.

Push the button **Sheet list** to open a window with full information corresponding to current state of the block sheets: total number of sheets, number of selected sheets to be orthorectified and the information about each separate sheet: file name, border and status (create orthoimage / not create orthoimage).
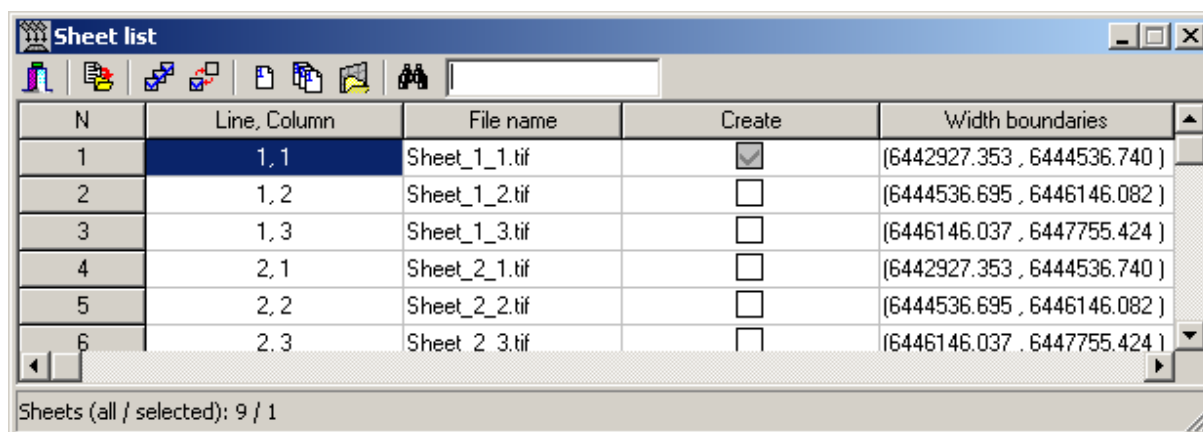
In this window you can change the sheet status (create/skip) by checking/clearing the check box in **Create** column.

For editing of file name of selected sheet push the button (**change sheet name**) and input new name in the window appeared. For editing of selected sheet name you can use the following keys: **F2** – to start editing, **Enter** – to save new name, **Esc** – to cancel changing.

If you need to change all sheets names push the button (**rename created sheets**), which opens a window intended for renaming of all mosaic sheets in the following way.

Mosaic sheets renaming

Input new sheet name in the **Base sheets name** field and its starting number in **First sheet number** field. In the **First sheet** panel select the position of a sheet which number is start of numeration for the whole sheets block. For that indicate a number of row (starting from the bottom of mosaic scheme) and column (from leftmost one on scheme) in appropriate fields.

You may indicate the **Renaming direction (bottom-to-top** or **top-to-bottom** on scheme), and also input a step value for sheets numeration increasing (in **Sheet number step** field).

For renaming of sheets that are skipped during mosaic creation, mark **Use skipped sheets** check box (they have no numeration by default).

You can select all sheets in the list using the icon **Select all**, and invert previous

selection by the icon **Invert selection**.

To search a sheet by its name or name fragment in the **File name** column of sheets list,

input symbols into search field and push the button **Find sheet** or press **Enter**.

To save splitting into sheets which is displayed in this window into vector resource of

PHOTOMOD system, push the (**Save**) button and in the opened dialog box set an attribute, into which the names of sheets should be written, and then the name of output resource.

To exit **Sheet list** window click the icon or cancel parameters editing by clicking **Esc**.

Note. Block must contain at least one sheet. When the number of sheets is one its status is always "To be created" and it cannot be excluded from processing
Once splitting parameters are selected, push **OK** and open preview window with splitting results, see the chapter Splitting preview.

9.2. *Splitting preview*

To display the results of splitting mosaic into sheets push the icon of the main icon bar or select menu command **Mosaic | Preview** to open Preview window.
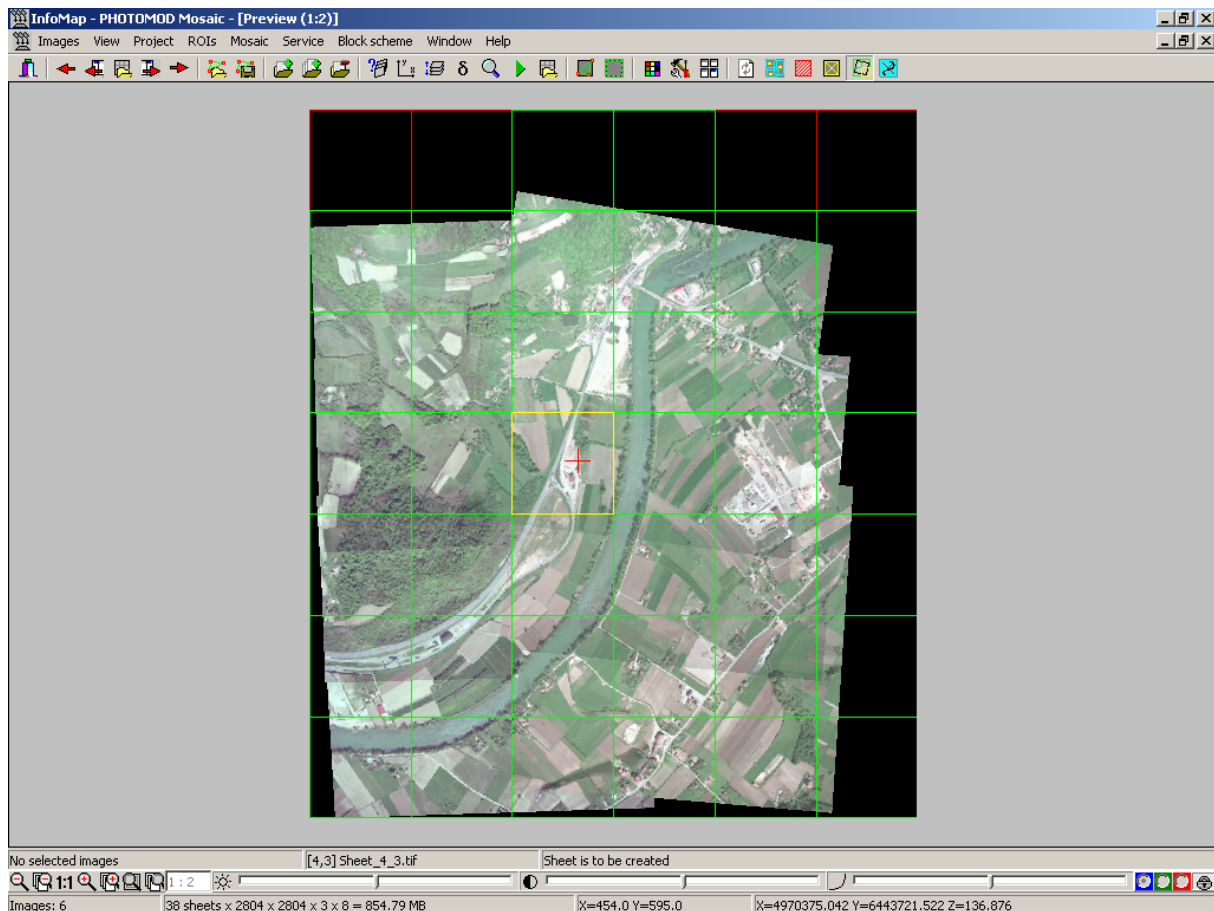
Preview of splitting into map sheets

When the button (**Sheet extents**) is pushed, click the selected sheet in preview image and it will be bounded by yellow frame and its file name will be displayed under preview window. Its **Status** parameter can be one of two choices – **to be created / to be skipped**. The lower string of the window (**Status**) shows the number of map sheets and a volume of resulting mosaic in kilobytes.

Frame of a sheet to be created is green and of a sheet to be skipped – red.
To include / exclude selected mosaic sheet from processing (change its status) use mouse double click in preview window.

You can select and include/exclude a group of map sheets to/from output mosaic on preview image by the following ways:

- When using **regular** or **by images** splitting on map sheets (see the chapter Splitting mosaic into map sheets) you can include/exclude sheet's group by frame using mouse along with **Shift** key pressed. For that click sheet in a corner of group (its border becomes yellow), then click opposite corner of a group along with **Shift** key pressed. If the first sheet selected was excluded from output mosaic, the whole group of sheets will be excluded either.

- When using custom sheets (created using the option **Sheets extents from resources**, see the chapter <u>Splitting mosaic into map sheets</u>) you can exclude sheets by frame using mouse along with **Ctrl-Shift** pressed.

- To include custom sheets by frame use mouse along with pressed **Ctrl** key.

Note. Block must contain at least one sheet. When the number of sheets is one its status is always "To be created" and it cannot be excluded from processing

You can create frames and marginalia for mosaic sheets in styles and symbols used in Russian State Land Use Survey in 1:2,000 1:5,000, 1:10,000 and 1:25,000 map scales for MicroStation and MapInfo systems, see the chapter <u>Creating marginalia for orthophotomap</u>.

9.3. *Load sheet coordinates*

The following procedure may be used to create mosaic sheets borders in PHOTOMOD Mosaic project:

Create a file in any text editor (like Notepad) and save it with the *. CSV extension, filling it with coordinates of the sheets borders with the following pattern:

Name, X1, Y1, X2, Y2, X3, Y3, X4, Y4

Where
Name - the alleged name of the sheet
(Xn, Yn) - coordinates of the n-th vertex of the border
for example:

Sheet_1,535017.208,164805.265,535517.248,164805.265,535517.248,165305.305,535017.208,165305.305
Sheet_2,535517.208,164805.265,536017.248,164805.265,536017.248,165305.305,535517.208,165305.305
Sheet_3,536017.208,164805.265,536517.248,164805.265,536517.248,165305.305,536017.208,165305.305
Sheet_4,536517.208,164805.265,537017.248,164805.265,537017.248,165305.305,536517.208,165305.305
Sheet_5,535017.208,165305.265,535517.248,165305.265,535517.248,165805.305,535017.208,165805.305

To import the text file (see chapter **Import-Export** of **Project processing** User manual), use the menu command **Vectors | Import | CSV**. A dialog opens to select the imported file that contains the coordinates of the sheet cutting and attribute names of the sheets. Once the desired file is selected, a window **Import data from CSV** opens.
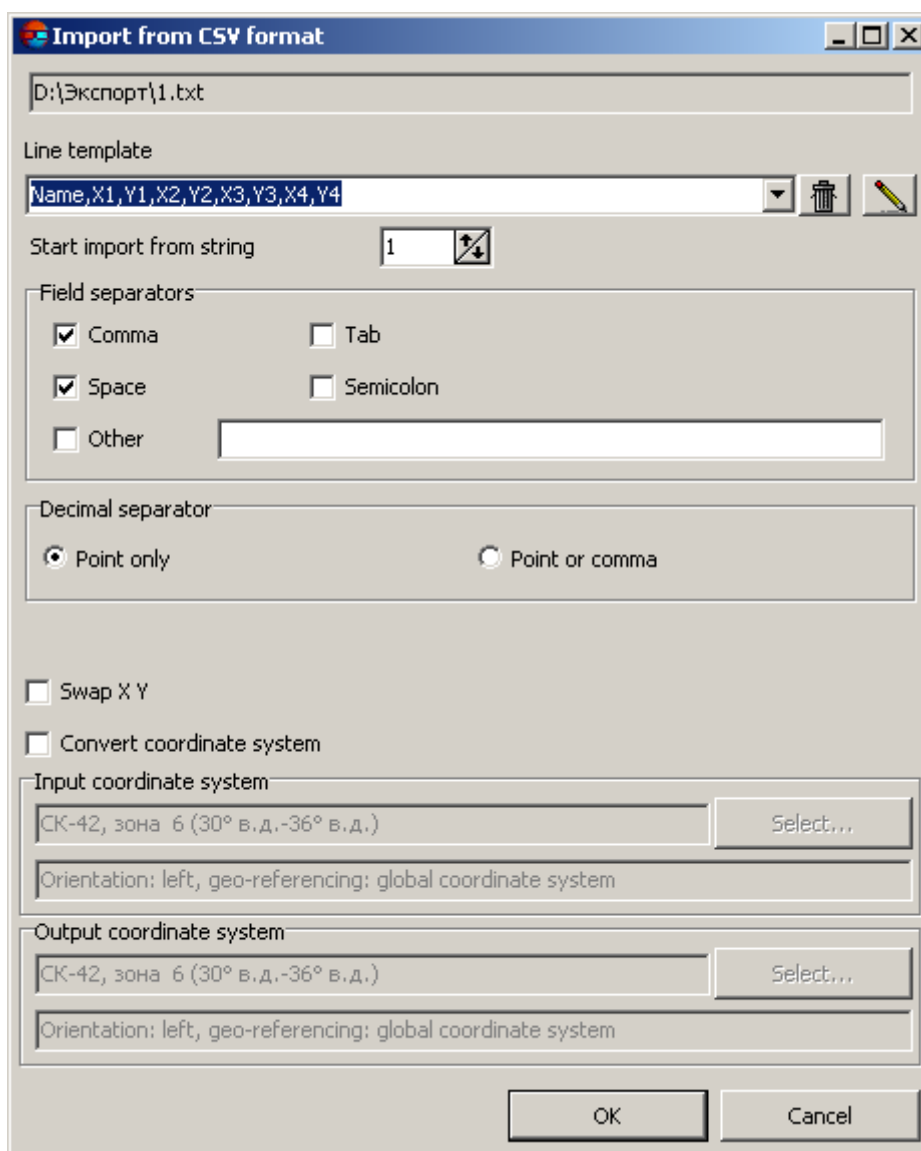
Push the **OK** button to perform import.

To load the imported sheets frames into PHOTOMOD Mosaic, save them in PHOTOMOD internal format using the **Vectors | Save as menu** command, choosing any name for the resource with frames coordinates and names.
Open the PHOTOMOD Mosaic. To load sheets data, go to the **Mosaic | Settings | Cutting into sheets** tab. Dialog for selecting a file to load is opened by pushing the ⋯ button.
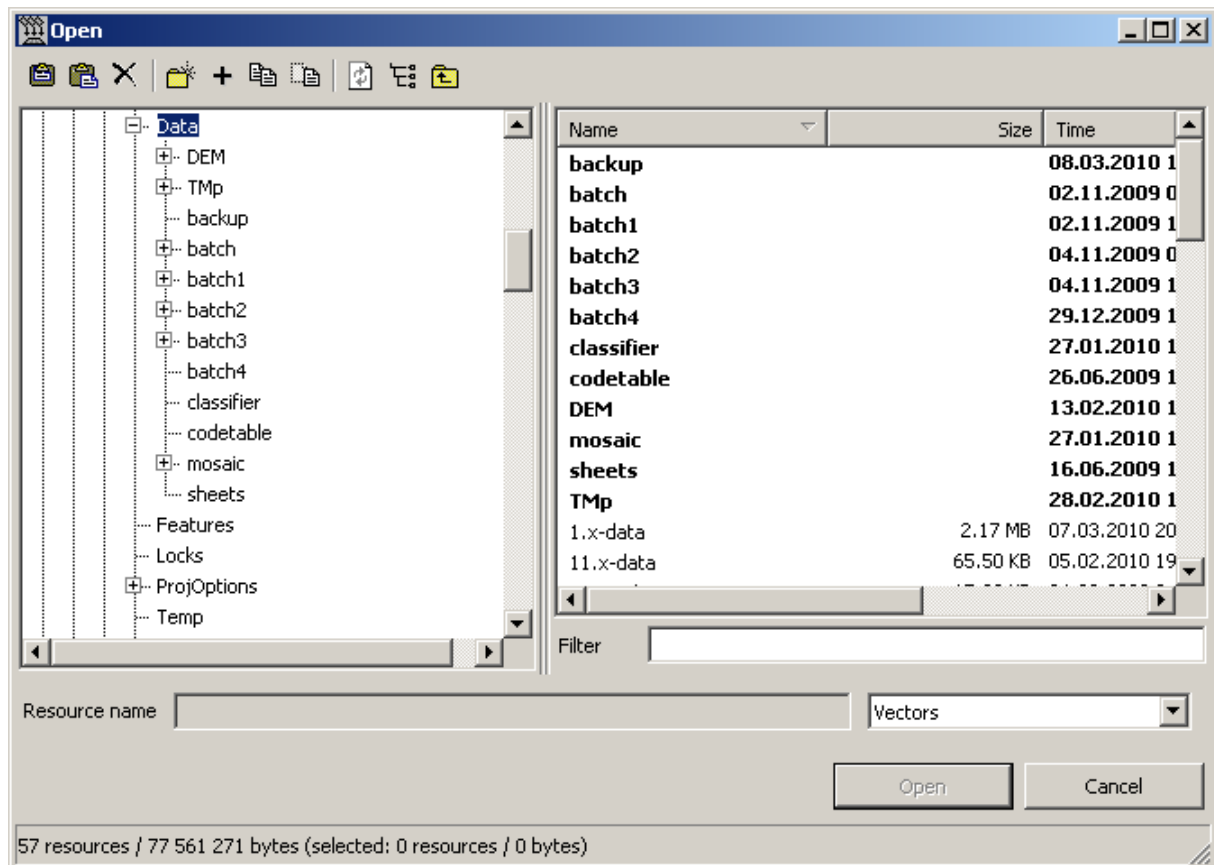
The **Options** dialog box opens once the desired file is selected.
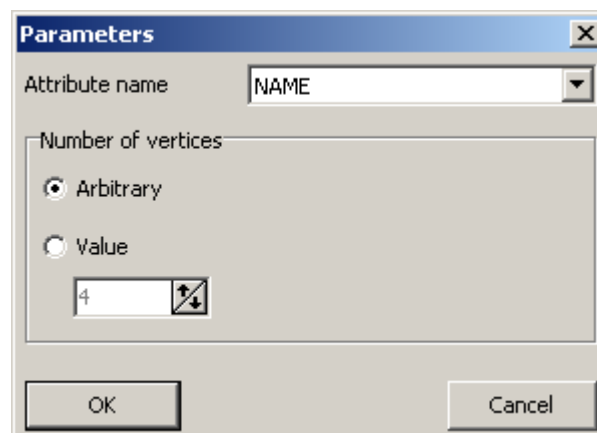
The **Attribute name** field defines attribute, values of which correspond to names of the sheets (see chapter **Import from CSV format** of **Project processing** User manual). The **Number of vertices** field allows selecting, polylines with which number of vertices would be used as sheets. It can be either **Arbitrary** (all objects would be loaded) or a **specific Value**. Push the **OK** button.

The similar workflow may be used to import mosaic sheet frames into PHOTOMOD Mosaic project from any other external vector format (see **Import/Export** section of **Project processing** User manual.

Note: 4-point sheet frames may be imported from CSV format into ordinary vector layer without classfier. If there are any sheets with vertices number other than 4, it is necessary to use DXF format and a layer with classifier.

If it is necessary to use a vector object created in PHOTOMOD Core as the boundaries of the sheet, the object must be created in a layer with classifier and assigned the name of the sheet using the **Window | Objects attributes** menu command (see **Project processing** User Manual).

10. DEM with variable resolution

Before the mosaic creating, you should pre-set the parameter **Interpolation cell sizes** (see the chapter DEM from TIN), which is applied to the initial grid step. However, in some special areas (for example around the bridges), where the mosaics resolution should be higher, you have to select the areas for more accurate mosaic creation. The areas could be selected by clicking the icon [icon] on the cutlines editor panel [icon] (see the chapter Creating and editing Regions of Interest). In that case, the DEM with variable resolution will be applied to different areas, that allows to optimize the mosaic's creating.
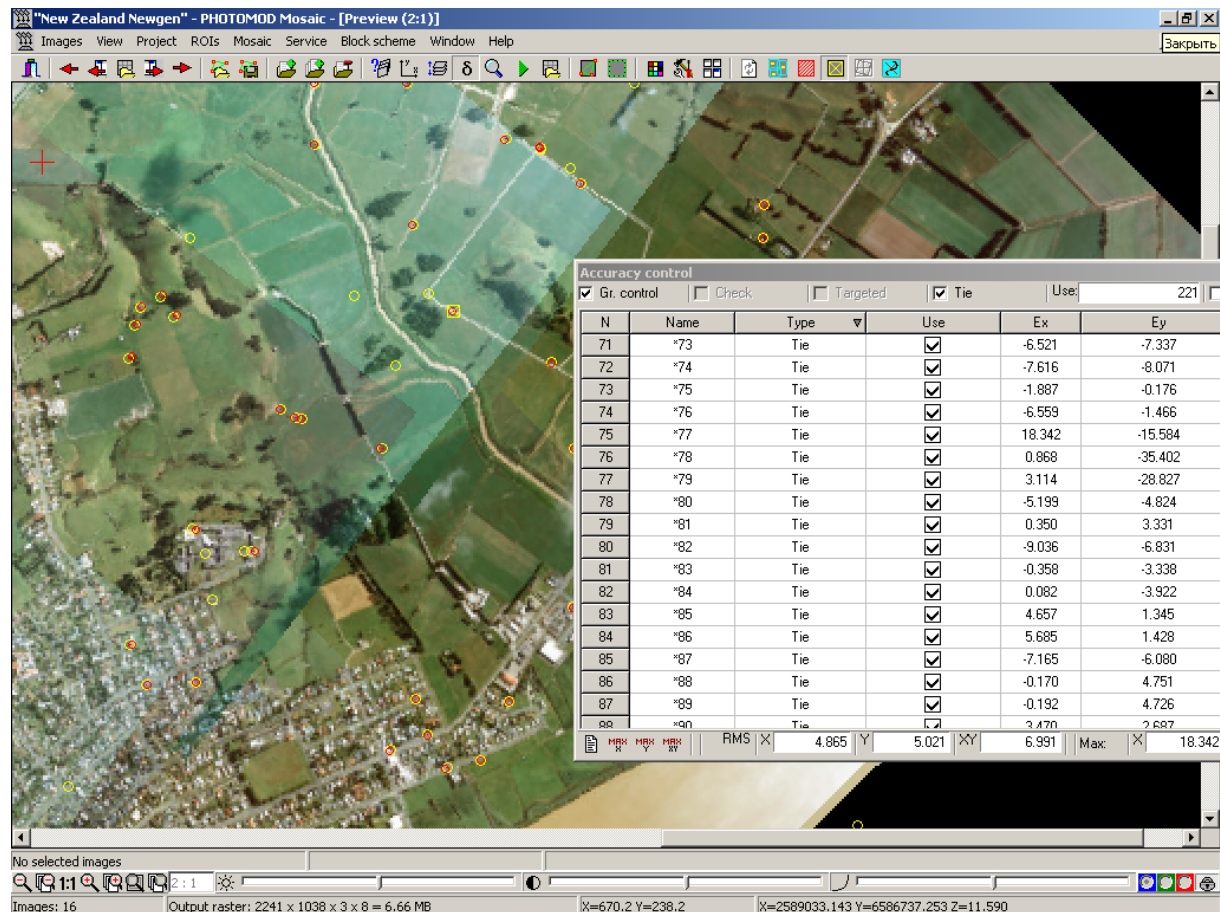
11. Orthorectification accuracy control

11.1. *By triangulation points*

PHOTOMOD Mosaic allows you to control an accuracy of the orthorectification process (it calculates the residuals in X and Y coordinates for ground control, check, targeted and tie points). To view the residuals select menu command **Mosaic | Accuracy control** or click the icon [icon] of the main icon bar. As a result the following window opens:

Accuracy control window

In this window you can view X and Y residuals for each point as well as RMS error for all points and maximum X and Y residuals. You can exclude point from RMS and Maximum calculations by clearing of check box in the **Use** column. If you have a big error (which significantly differs from the adjustment results) on some point, check the TIN around it during the project processing. Probably it contains some artifacts. Note that if the control point is placed on the roof of building or somewhere else, not on the ground, the corresponding error occurs due to height difference of objects.
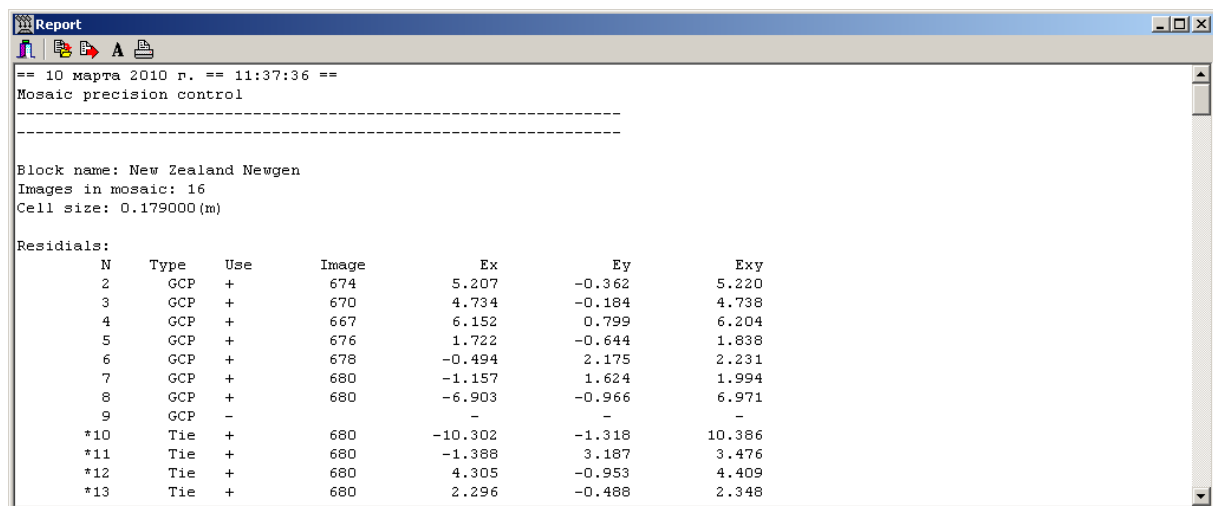
The **Max** buttons are used to select a point with a maximum error value. If there is an **Orthomosaic** (see the chapter Building orthomosaic) or **Preview** (see the chapter Preview) window on the screen you can select a point in the list and estimate its position on the image – marker on orthoimage moves to selected point's position.

Red color on the image shows error vectors, which are directed from the ground position of triangulation points to their rectified position on orthoimage. Red vectors are helpful for estimation of size and direction of this shift.
Points list shown in the table is sorted by name, type, and also by X, Y and XY deviations, using mouse click on the appropriate column header.

The **In use only** option allows to hide points excluded from mosaic building (points with red circles in the **Use** column). There would be many of such points in case of import from PAT-B.

List of control, tie and check points opens by clicking the button ▤ **Report** located in left lower corner of the window. The following parameters are shown for each point: point type; image name, where the point is located; X, Y and XY residuals. Besides, at the end of the table there are the following total parameters – RMS, maximum "-", maximum "+" deviations and mean absolute – which allow estimating the orthomosaic accuracy.

Orthomosaic accuracy control report window

Push the ▤ **Save** icon to save this information to the text file or use the icon ▤ **Print** to print it.

You can also change report's font (the **A** button) or close this window without saving to file (the ▤ button).

Since the orthorectification process works with the regular surface model (DEM) but the source relief model is TIN (in case of model type **Convert TIN to DEM** – see the chapter Type of DTM) the accuracy of the output orthoimage also depends on the accuracy of DEM-TIN conversion. To estimate the DEM-TIN conversion errors turn ON the option **Calculate DEM errors** on tab **Service | Preferences | General** (see the chapter Preferences). The errors are differences between source TIN nodes and corresponding DEM cells in Z coordinate. After DEM creation appears a window, which displays Maximum error, Average error and RMS. Decreasing a value of **Interpolation cell size** parameter (see the chapter Type of DTM) reduces the errors since in this case the DEM "describes" a source TIN more precisely.

Loading and viewing control vectors or points from a vector resource may be used as an additional way to control accuracy of created orthphoto. This option is available only when there is an open window with orthophoto. To load e.g. control points, use menu command **Mosaic | Load vectors | XYZ-points**. For assessment of orthophoto accuracy it may be convenient to use the distance measurement tool described in the Measurement over orthomosaic section.

11.2. *On cutlines*

You can create report about accuracy of orthophotomosaic creation not only by triangulation points but on cutlines either. The operation of accuracy control creates small fragments of orthophotos of adjacent images along cutlines. Then the program compares them and calculates mutual discrepancies, then shows them in the report.

Parameters of the process are setup in the window opened by menu command **ROIs | Cutlines accuracy report** as follows.
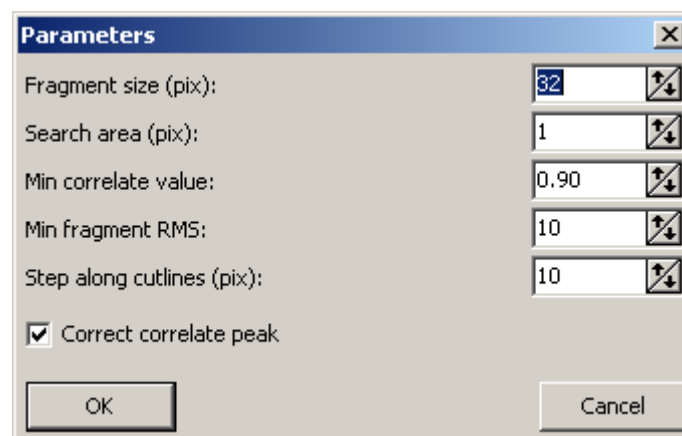
Parameters of accuracy control by cutlines

- **Fragment size (pix)** – size of orthophotomosaic fragments, built using current settings of PHOTOMOD Mosaic (DEM, pixel size, etc.)
- **Search area size (pix)** – maximal supposed size of mutual discrepancy used during search.
- **Min. correlation coefficient** – minimal value of correlation function, under which fragments from adjacent images are considered of the same name.
- **Min. fragment RMS** – minimal value of RMS of fragments brightness, under which the fragments are considered as nonhomogeneous background (water surface, etc.), i.e. suitable for comparison.
- **Step along cutlines (pix)** – step along cutlines in pixels. The less the value the more points are included to the report, but the more time is consumed for search.
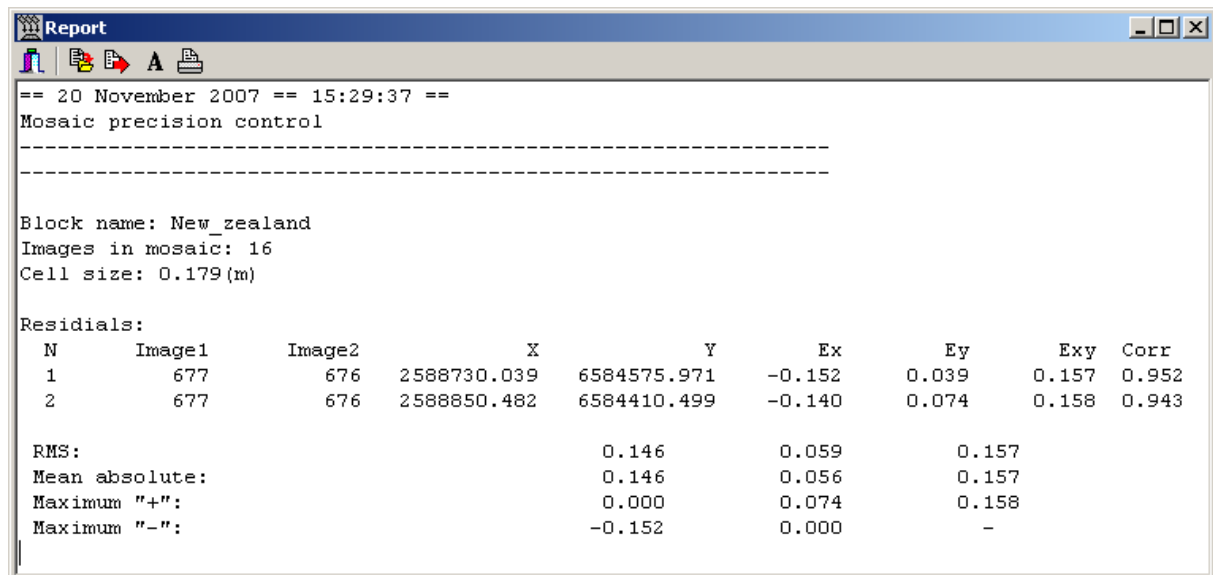
Report on accuracy control on cutlines

12. Building orthomosaic

12.1. *Building and viewing orthomosaic*

Mosaic creation is started by menu command **Mosaic | Build!** or by clicking the icon ▶ of the main icon bar, that opens standard OS Windows dialog of output file name selection (**Save as** window). In case of splitting the mosaic into sheets (if the appropriate option is ON, see the chapter Splitting mosaic into map sheets), the dialogue appears, allowing you to input file name of output map sheets (see the chapter Sheet file names).
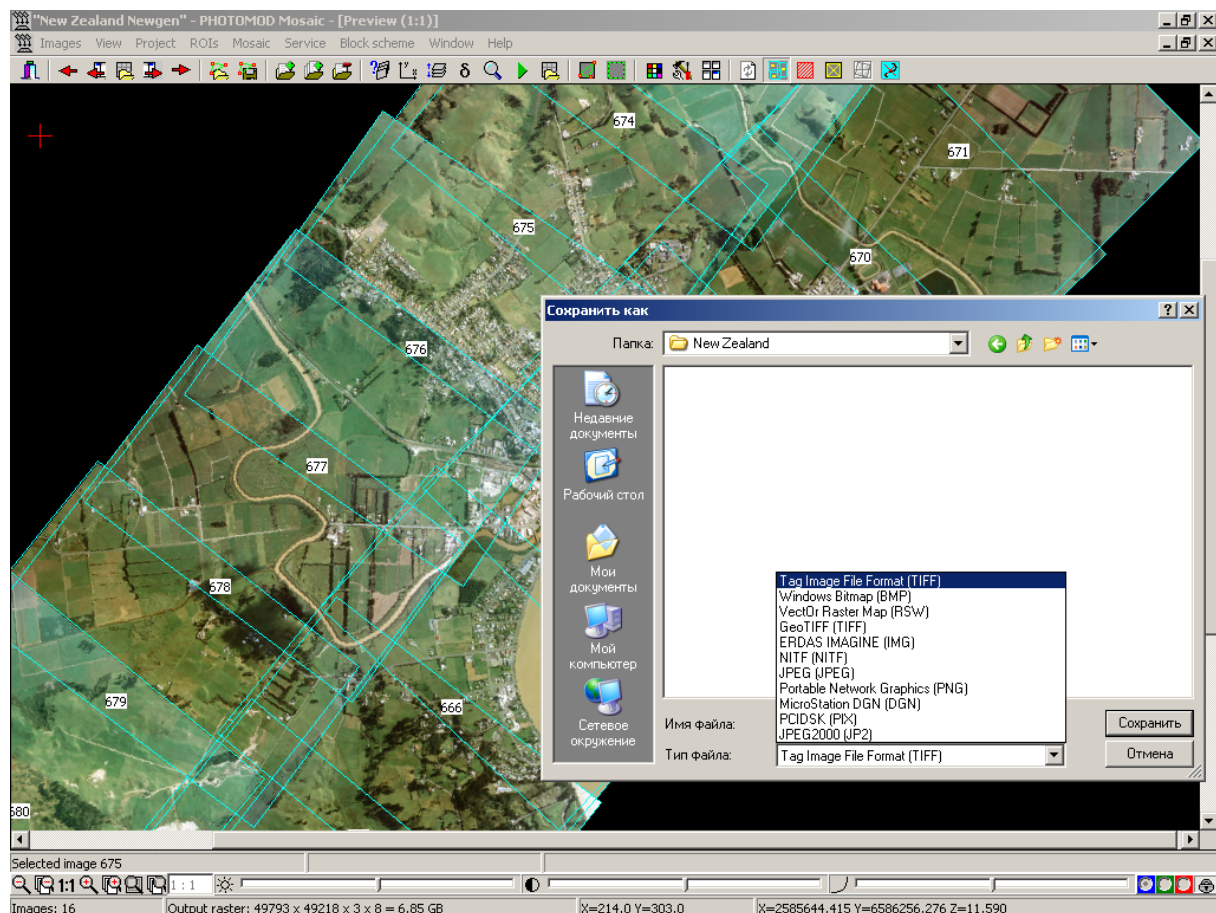
Selecting output mosaic format

The orthomosaic is created in the following output formats selected from drop-down list:

- **Tag Image File Format (TIFF)** – allows to save output mosaic with or without JPEG compression (depending on the option in **Mosaic | Parameters | Orthoimage** window, see the chapter Orthoimage
- **Windows Bitmap File (BMP)**
- **VectOr** format (see the chapter Export orthomosaic to PHOTOMOD VectOr)
- **GeoTIFF** – TIFF format, containing special tags with georeference data. This option is not available for local and Cartesian coordinate systems
- **ERDAS IMAGINE (IMG)** – raster format of ERDAS system
- **NITF (NITF)**
- **JPEG (JPEG)**
- **PNG (PNG)**
- **DGN (DGN)** – raster format of MicroStation system, allows to save adaptive color palette for output mosaic
- **PCIDSK (PIX)** – raster format with georeference data in its header, developed by PCI Geomatics
- **JPEG2000(JP2)** – raster format with jpeg-compressing and georeference data in its header, output image in this format has volume limited up to 500 Mb.

After path and file name input push the **Save** button to start mosaic creation. At that georeference file is saved along with orthomosaic file in the same folder, see the chapter Georeference file.

When the building is complete a window with output mosaic opens, if the option **Display output mosaic** is ON (see the chapter Preferences).
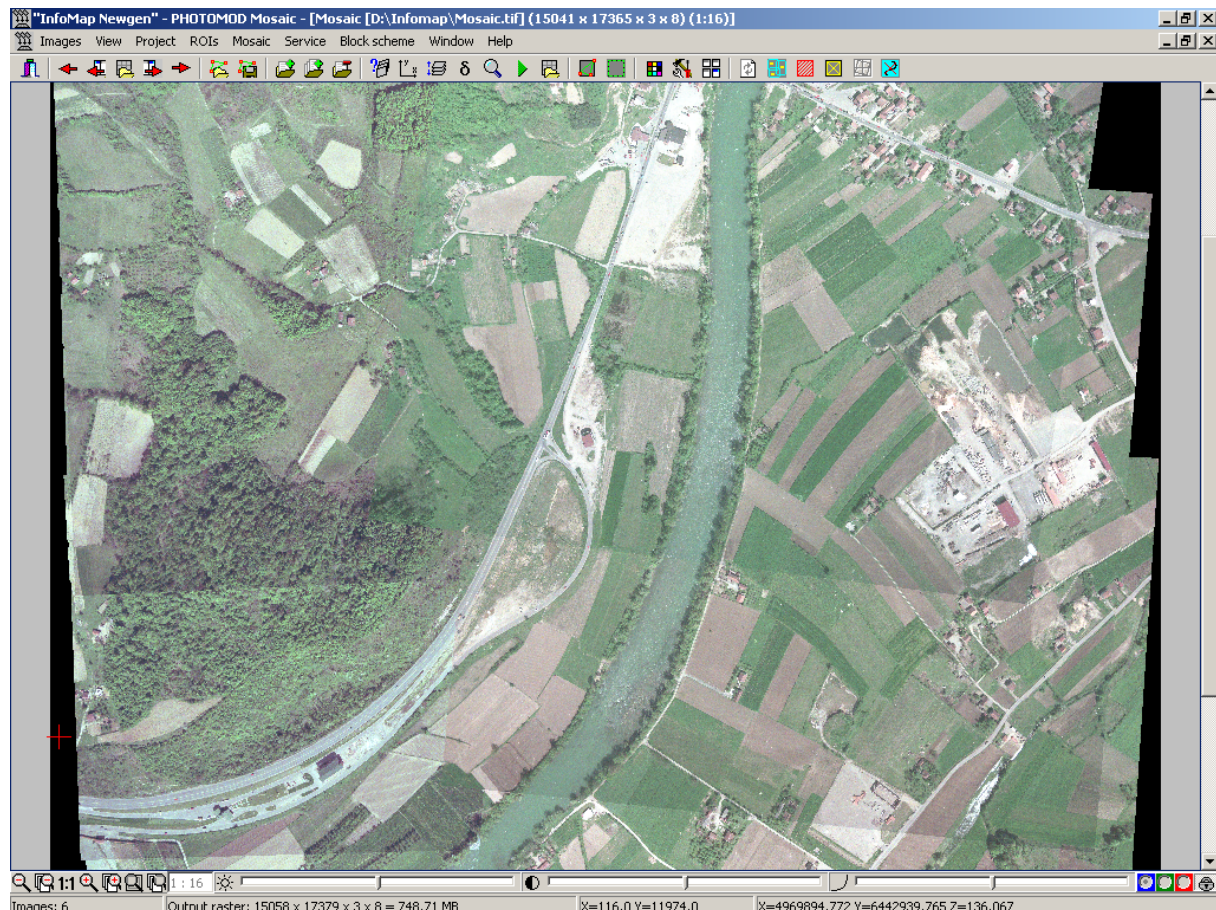
Window of output orthomosaic

At the lower left part of orthomosaic window there are standard icons for raster image managing:

- - one step zooming out (duplicated by "**/**" key)

- - one step zooming out (duplicated by "**/**" key) for all images opened

- **1:1** - 1:1 mode (image cell corresponds to the screen pixel) (duplicated by "**Alt-1**" keys)

- - one step zooming in (duplicated by "*****" key)

- - one step zooming in (duplicated by "*****" key) for all images opened

- - fitting the whole image into the window (duplicated by "**Alt-Enter**" keys)

- - zoom all images to fit in windows (duplicated by "**Shift-Alt-Enter**" keys)

Current image zoom is shown in title bar in brackets after image name and in the lower part of the window as 1 : 49 .

You can also use the following key combinations to zoom or move arbitrary image fragment:

- **Ctrl + Alt + mouse**   zooming in by zoom box, "drawn" by mouse
- **Ctrl + Alt + Shift + mouse** zooming out by zoom box
- **Alt + mouse**   panning the image
- **Mouse wheel**   mouse wheel steering allows to zoom in/zoom out image on the screen

Following sliders (, ,), located at the bottom of the window, are used to set up brightness, contrast and gamma respectively for the active image. When working with color

images there is a possibility to adjust these radiometric parameters separately by channels (using the buttons ![icons]). Right click any slider and select the option **Set original BCG correction** to restore BCG settings by default.

Note. These settings are temporary and do not affect the mosaic file

Show the regions of interest on the output orthomosaic by pushing the icon ![icon], that allows also using save/load operations for ROI's.

For convenient assessment of cutlines quality on created orthomosaic, there is an option for displaying cutlines as double lines offset from the actual cutline rather than single lines over the cutline. In order to enable this function, it is necessary to set **Cutlines offset for mosaic view** parameter on **Additional** tab of **Preferences** window to non-zero value. After that, the cutlines will be displayed as shown:

Note: In this mode, in areas where several cutlines meet or cutlines have sharp angles, the double line may have visible artifacts.

Show triangulation points on screen by pushing the icon ![icon]. If you start precision control operation (see the chapter <u>Orthorectification accuracy control</u>) you can select a point in the list and it will be also selected on the image.

Note. Current coordinates of marker on the preview image (in project coordinate system) are shown in the rightmost field of Status panel. You can copy them to clipboard (by Ctrl-C) and paste afterward into chosen application (by Ctrl-V)

12.2. *Building orthomosaic for the block fragment*

You can select a rectangular area in the Preview window (see the chapter <u>Mosaic preview</u>) to create mosaic only for corresponding portion of the source block of images. Use **Shift + left mouse** button to draw a rectangle on the image. You can resize the polygon by dragging special marks on its sides or move it by the mouse. To input coordinates of the fragment corners from the keyboard use the **Coordinates** window, opened by menu command

Mosaic | Coordinates or by the icon ⌐. Once the fragment is specified, start mosaicking

in a standard way (by clicking the ▶ icon or menu command **Mosaic | Build!**). This mode is useful for quick visual results control on small mosaic portions.

12.3. *Orthomosaic editing in Dust Correct application*

After orthophoto building you can "clean" the artifacts there – images of dust particles, photo emulsion defects etc. For this purpose, you can use special application **Dust Correct**, which

opens by pushing the icon 🔀 in main menu of **PHOTOMOD Mosaic** module.

Note. Dust Correct application works with the images in Windows BMP and Stripped SingleScale TIFF formats without compression. If you try to open the image of any other format, it will open in "read only" mode

Open the image selected from the list appeared after clicking main menu command **File |**

Open image or the hot keys **Ctrl-O** or pushing the icon 📂.

For the convenient search of the artifact, zoom in the initial image (by the hot key "*****", for instance) and find the defect using panning the image by hot keys **Alt-mouse** or by the keyboard (**Shift-keyboard arrows**). Then select the fragment, containing not only artifact but also an image part with similar texture for substitute (cleaning) the image.
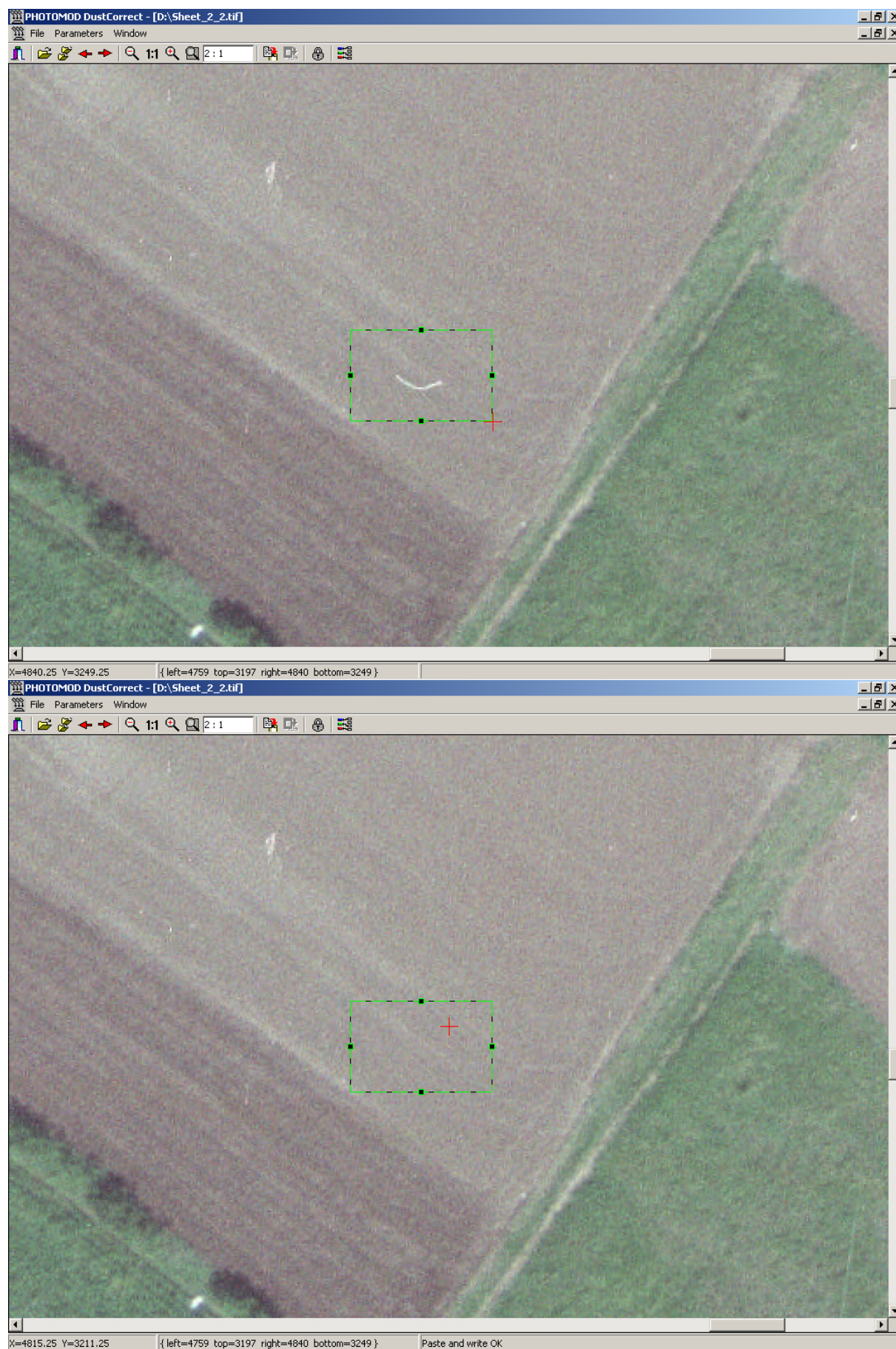
Image processing result in Dust Correct application window

For selecting the fragment by green frame use **Shift-mouse** combination, to cancel selection click **Esc**.

You may open and edit the fragment selected either in **PHOTOMOD** built-in editor or in external software. To open selected image in built-in editor open the Parameters panel using menu command **Parameters | Parameters** and check out the option **Use internal editor**.
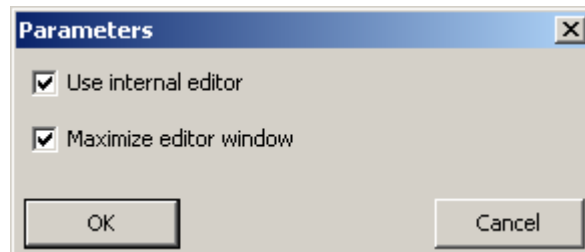
Then copy the fragment to the clipboard (using standard OS Windows command – **Ctrl-C** or pushing the icon [icon] **Copy to clipboard** of **Dust Correct** main menu). After that, the Editor window containing the fragment selected opens.
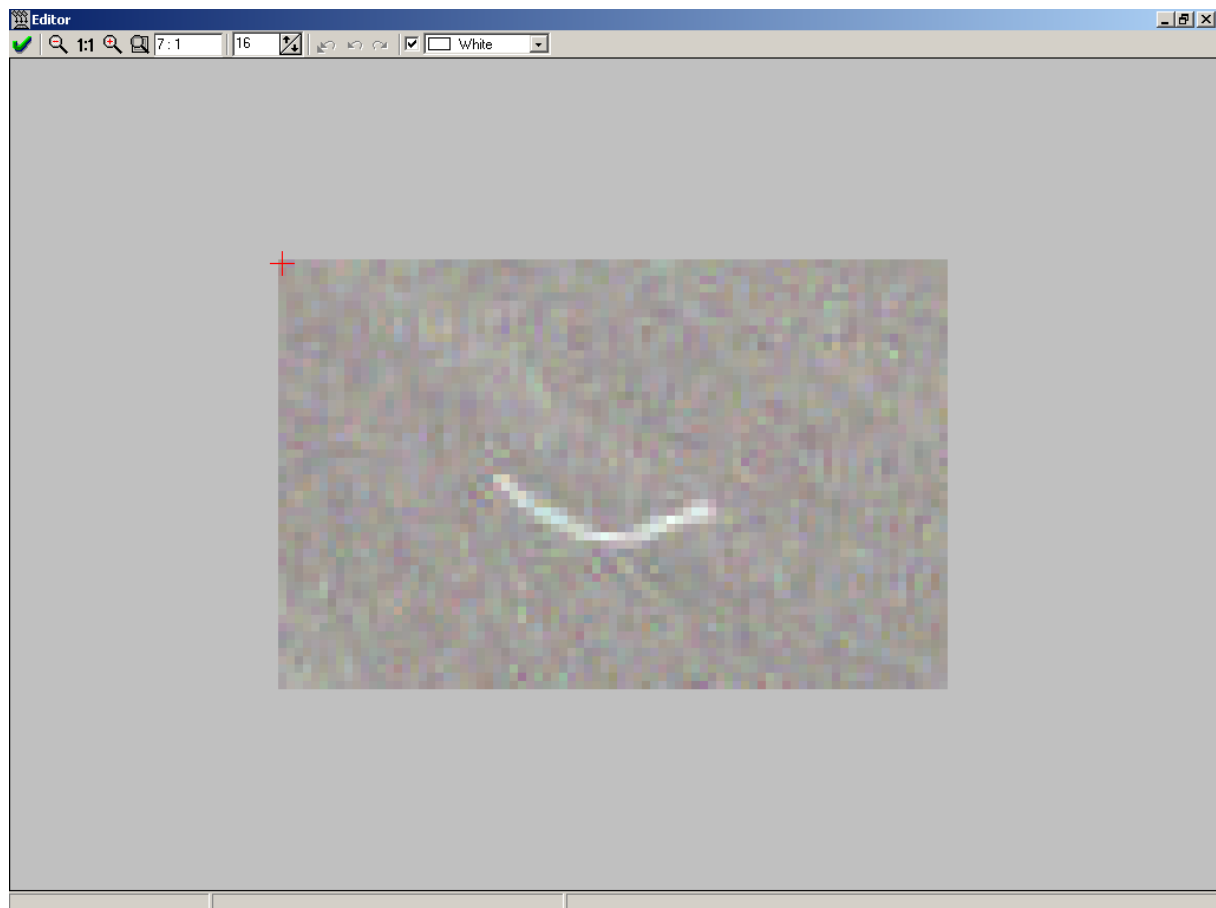
Editor window

In the **Editor** window place the mouse cursor in the "source point" (by **Shift-mouse click**) – the exact place, where the image texture fits closely the needed one. At that you can set the aperture value (in the upper numeric field [16 icon]) – the diameter of the circle around the "source point", which is the source of the "patch" texture. Afterwards clean the artifact using mouse moves. Use the following buttons to perform undo/redo operations:

 - undo all – to cancel all actions in the Editor window

(or **Ctrl-Z** shortcut) - cancel – to cancel the last action in the Editor window

(or **Shift-Ctrl-Z** shortcut) - redo – to redo cancelled action.

Quite often images to process in **DustCorrect** contain at the borders non-informative part such as background with constant value of brightness and color. It is obvious that image correction at the borders of raster images and background could lead to changes of pixel values of background. This is inadmissible, because during further processing may a necessity appear to separate background and raster image by values of brightness and color. For correct processing of raster images at borders an option was added to take background color into account [✓ ☐ White ▼]. For correction not to affect the background, it is necessary to enable the option and select the appropriate color. Drop-down menu for color selection contains 3 points: **Black**, **White** and **Other**. When choosing **Other** item, the standard Windows palette window is shown for color selection.

When obtained satisfying result push the icon [✓] that closes the **Editor** window and allows to return to the **Dust Correct** window and paste edited fragment. To cancel editing results and exit without image change, just close the **Editor** window.

Also for convenience in cleaning raster images from artifacts in joints, it's possible to upload multiple images in one window by pressing [icon] button or key combination **Shift-Ctrl-O**. For actions order image corrections please see chapter Orthomosaic editing in Dust Correct application

If you prefer to edit the image in the external graphic software, copy the image or its fragment there by standard OS Windows operations copy/paste (**Ctrl-C**/**Ctrl-V**) or use the icons [icon] **Copy to clipboard** and [icon] **Paste from clipboard**. At that the option **Use internal editor** in **Parameters** panel (opened by menu command **Parameters | Parameters**) should be cleared.

The icon [icon] (**Disable changes**) or **Ctrl-L** shortcut is used for fixation of the fragment frame size, intended for external editing (to fit its former place after editing).

12.4. *Measurements over orthomosaic*

There is a possibility to make control measurements of distances on the orthomosaic. Press the left mouse button, combined with the button **Shift**, drag a line to the point you need and release the buttons. You will get a distance value **L** displayed at the bottom of window. This operation is useful for example for estimation of orthomosaic accuracy along the cutlines. To perform an additional accuracy control of the orthomosaic you can load "external" control points from a text file (consisted of strings with X and Y coordinate values delimited by comma or space). Beside triangulation points visualization on mosaic (if the [icon] icon is pushed) and automatic errors calculating on them (see the chapter Orthorectification accuracy control), you can also load additional control points using menu command **Mosaic | Load vectors | XYZ-points**. Then you can measure distances between control points and corresponding terrain features on the orthomosaic. These shifts of points' position are shown in preview window as red color error vectors.

12.5. *Loading orthomosaic*

You can load and view previously created orthomosaic (using menu command **Mosaic | Open** or the icon or hot keys **Ctrl-Alt-O**) from the following formats:

- **Tag Image File Format (TIFF)** – selected folder should contain tiff file with mosaic and also georeference file with the same name (see the chapter Georeference file).
- **Windows Bitmap File (BMP)**
- **VectOr (SIT, RSW, MTW)** – raster format of **PHOTOMOD VectOr** system, see the chapter Export of orthomosaic to PHOTOMOD VectOr
- **IMG** – raster format of ERDAS system
- **NITF**
- **JPEG**
- **GIF**
- **PNG**
- **USGS DEM (DEM)**

12.6. *Roofs vectorization*

Traditionally, orthophotos are created using elevation model of the surface. But in case of city scape processing, the roofs of tall buildings on the resulting orthophoto may be shifted from their true position (foundation). The magnitude of this shift is determined by the building height and distance of the building from nadir point of the image. If further processing of the orthophoto is planned involving vectorization of the building by its roof, it is necessary to shift the roofs to their true position on surface.

In order to solve the task, a tool **Roofs vectorization** was introduced inside the PHOTOMOD Mosaic module, which permits outlining the roofs of the buildings on the source images and then use this information to shift the roofs to their true position. To use this tool, one should activate a window with a source image and the execute menu command Service | Roofs vectorization. This brings up a window with the same name containing the list of all roofs already digitized, displaying for each roof the order number, the height of the roof in the coordinate system of the project (not the building height!), and the number of vertices of the polygon describing the roof.
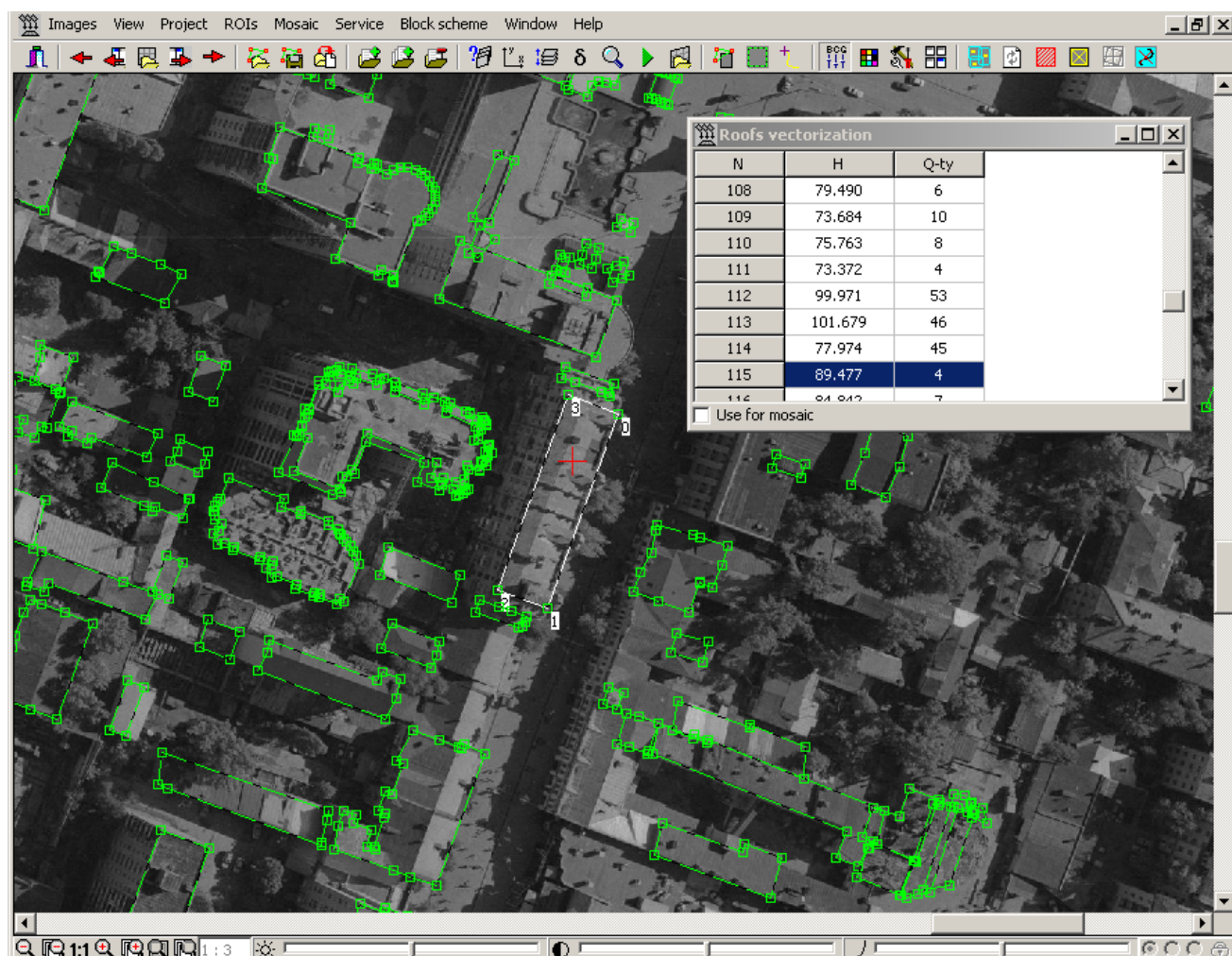
Editing polygons describing the roofs is fully identical to editing regions of interest (see chapter Creating and editing Regions of Interest). To set the roof height, it is necessary to right-click the **Roofs vectorization** window, which brings up the following popup menu:
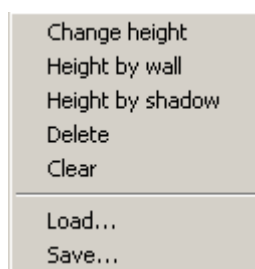
Change height allows user to set / change the height of the roof. When selecting this option, the following window opens:
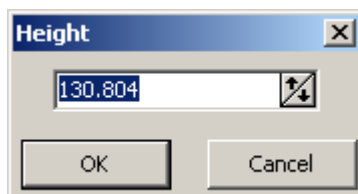
Note: This window is used to set the absolute height of the roof in the coordinate system of the project. So, the height of the building must be added to the terrain elevation at the point.

Height by wall - allows determining the roof elevation by measuring an edge of the building. In order to do this, it is necessary to position the marker to the building basement, then call the mentioned menu command, press left mouse button and drag the rubberline from the basement to the roof of the building, and finally release the button.
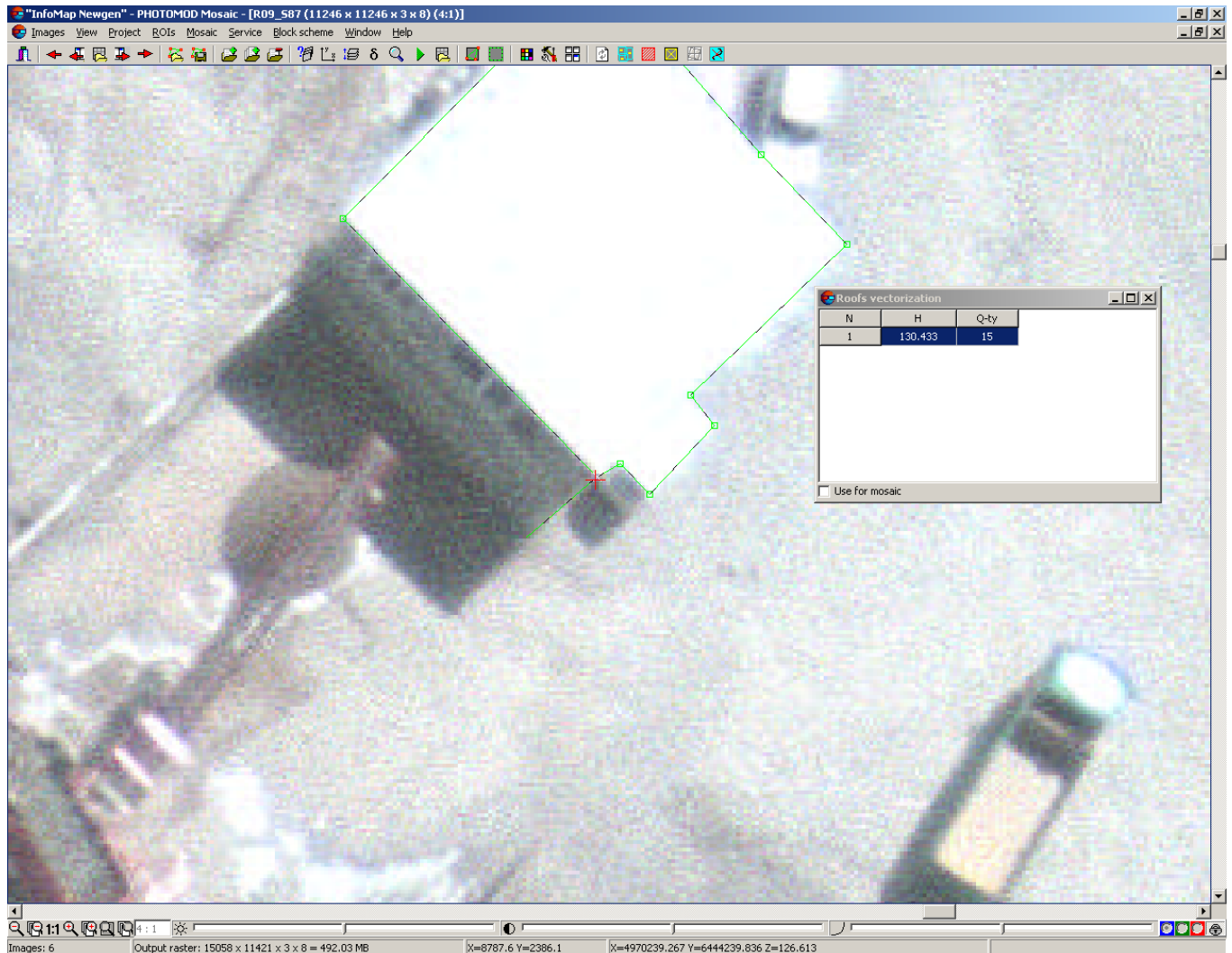
If the measurement has been performed correctly, a confirmation dialog with calculated building height in the coordinate system of the project appears.
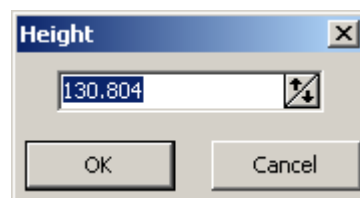
Pressing **OK** button in it assigns the height to the object.

If the window did not appear, it means that the system could not find a height value corresponding to the measured pixel coordinates displacements. In this case it is necessary to repeat the measurement.

The **Height by shadow** command allows calculating the height of the building via measurement of its shadow. This process includes placing marker to the building basement, calling the menu command, pressing left mouse button, dragging the rubberline from the basement to the edge of the building shadow and finally releasing the mouse button.
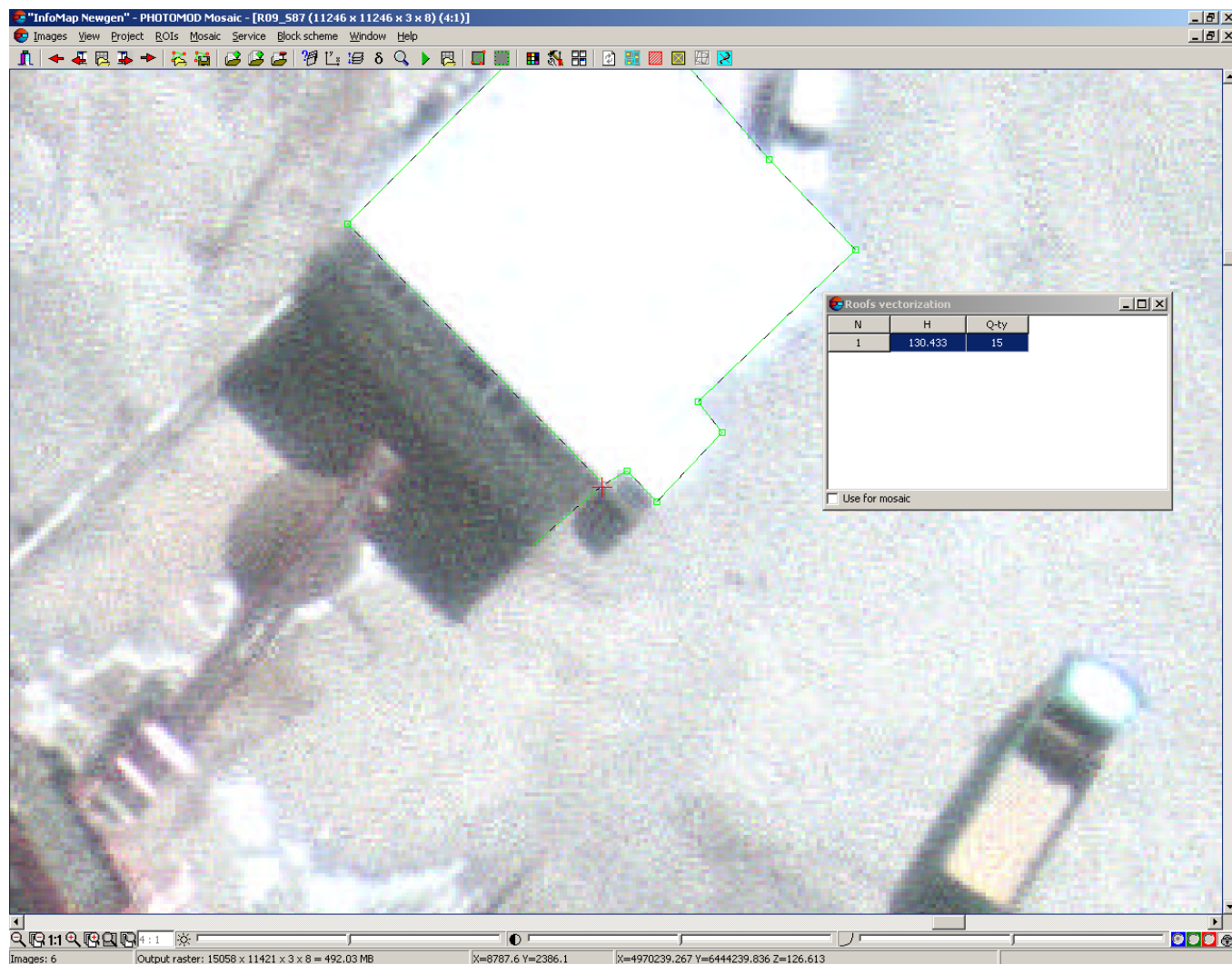
If the measurements are performed correctly, then following window opens:
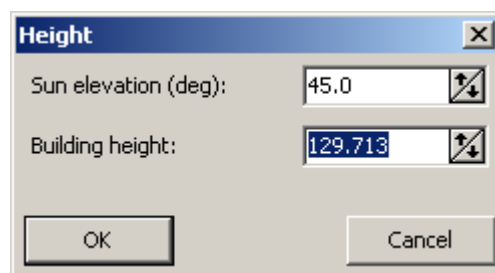
By setting the **Sun elevation** above the horizon at the time of surveying, we obtain the desired height. When pushing the **OK** button, the height is assigned to the current object. The window doesn't appear if it was not possible to calculate such height of the roof which would lead to the measured roof displacement on image. In this case the measurement should be repeated.

Delete - removes the roof selected in the **Roofs vectorization** window.

Clear - removes all the roofs after a warning message.

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Load - allows user to load vector objects vectorized or imported from external formats in **PHOTOMOD Core** as roofs. In this case the roof height is taken from the Z coordinate of the first vertex of PHOTOMOD vector object.

      Save - allows user to export vectorized roofs to PHOTOMOD vector resource.

The **Use for mosaic** option allows turn on / turn off taking into account of this information in the process of orthorectification.

      Note: When the roofs are shifted during orthophoto creation, their original position is filled with the mosaic background color.

12.7. *Creating marginalia for orthophotomap*

It is possible to create map frame and marginalia in styles and symbols used in Russian State Land Use Survey in map scales
- **1:2000**
- **1:5000**
- **1:10 000**
- **1:25 000**
- **1:50 000**

for MicroStation and MapInfo systems, using the command **Mosaic | Create marginalia**.
Marginalia contains the following data:
- **Decoration** – image frame, outer bold frame, text labels, scale segment, scheme of sheets, names of the negihbor sheets in frame cutouts.
- **Grid** – coordinate grid lines.
- **Frames** – frames of all the created sheets.

Marginalia for **MicroStation** consists of one **DGN** file for every orthophot sheet (containing *Decoration* and *Grid*), and a single file for the entire project contaning *Frames*.
Marginalia for **MapInfo** is saved as two (*Decoration* and *Grid*), or three (*Decoration*, *Grid* and *Text data*) **MIF/MID** file pairs per each orthophoto sheet, plus single *Frames* file pair for the entire project.

12.7.1. Workflow for creating marginalia

Described int this section is the workflow for creating marginalia for MicroStation in 1:2000 map scale symbols.
After the orthophoto itself has been created, execute the menu command **Mosaic | Create Marginalia 1:2000 | MicroStation DGN.**

Marginalia parameters

In the parameters window, set path to the output marginalia files, and adjust if necessary: contents of the text labels for outside the frame (in the **Names** tab), frame style (in the **Frame parameters** tab) and DGN specific parameters on the corresponding tab. After the **OK** button is clicked, DGN files containing marginalia are saved in the folder specified.

Open the created DGN file in MicroStation, then open corresponding orthophoto raster sheet (**File | Raster management | File | Attach**), and the program displays the orthophoto with marginalia.
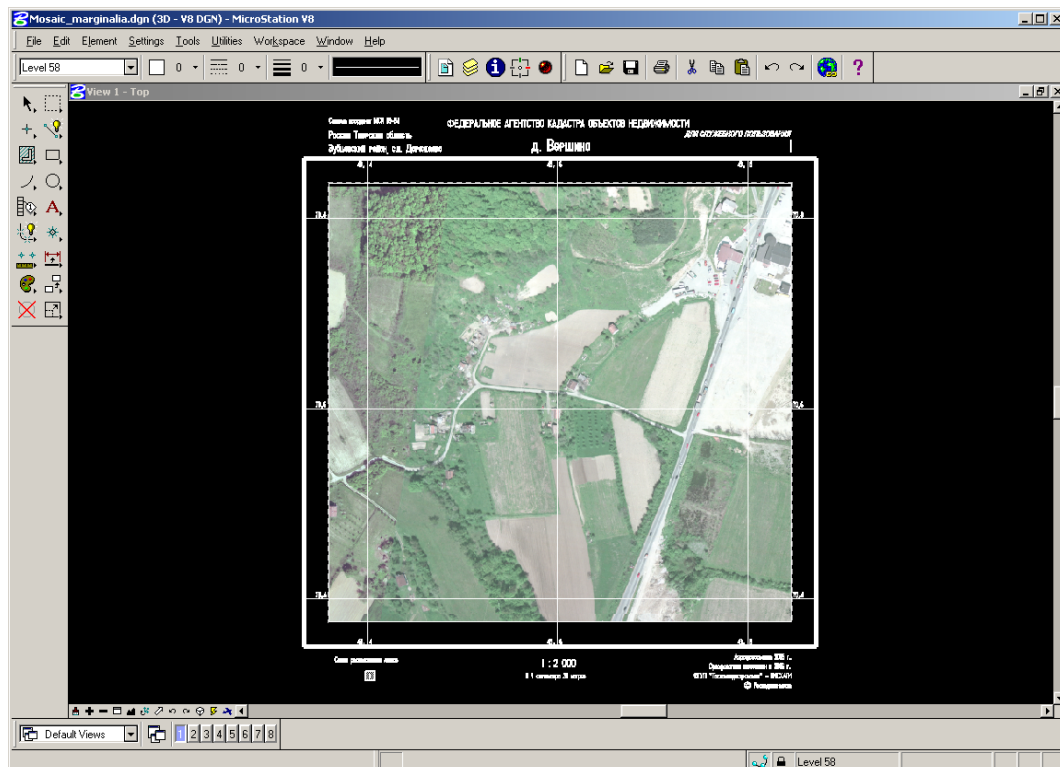
An orthophoto in MicroStation window

Marginalia can be created for the orthophoto as a whole as well as for the sheets in which it is split.

Sometimes it may be necessary to rename sheet image files together with marginalia files to working numbers.

When there is a CSV file containing necessary information (coordinates of sheet corners and nomenclature), Mosaic | Parameters | Split into sheets | CSV command may be used to set up renaming image and marginalia files to working numbers.

Besides, already created 1:2000 and 1:5000 orthophoto sheets with marginalia files may be renamed to working numbers. To do this, use menu commands Mosaic | Create Marginalia 1:2000 | Rename to work numbers or Mosaic | Create Marginalia 1:5000 | Rename to work numbers, when the preview window is open for the mosaic sheets of which are to be renamed. Then in the dialogue box that appears, select the folder where files with marginalia and files with sheets, which must be renamed, are stored. As a result of this operation, the files contained in the selected folder will obtain the names used in the **PHOTOMOD Mosaic** module by default, for example, **Sheet_1**, **Sheet_2** etc. Files extensions will correspond to their content: for example, tiff - for sheets files, tab - for sheets georeferencing in MapInfo, mif / mid - for files with marginalia.

If necessary the orthophoto marginalia, created in scales 1:2 000 and 1:5 000, may be configured in accordance with the requirements of the user. To do this, use the following commands:
Mosaic | Marginalia 1:2000 | MicroStation DGN (arbitrary)
Mosaic | Marginalia 1:2000 | MapInfo MIF / MID (arbitrary)
or
Mosaic | Marginalia 1:5000 | MicroStation DGN (arbitrary)
Mosaic | Marginalia 1:5000 | MapInfo MIF / MID (arbitrary).
In the window that appears, you can edit the layout parameters in the appropriate fields.
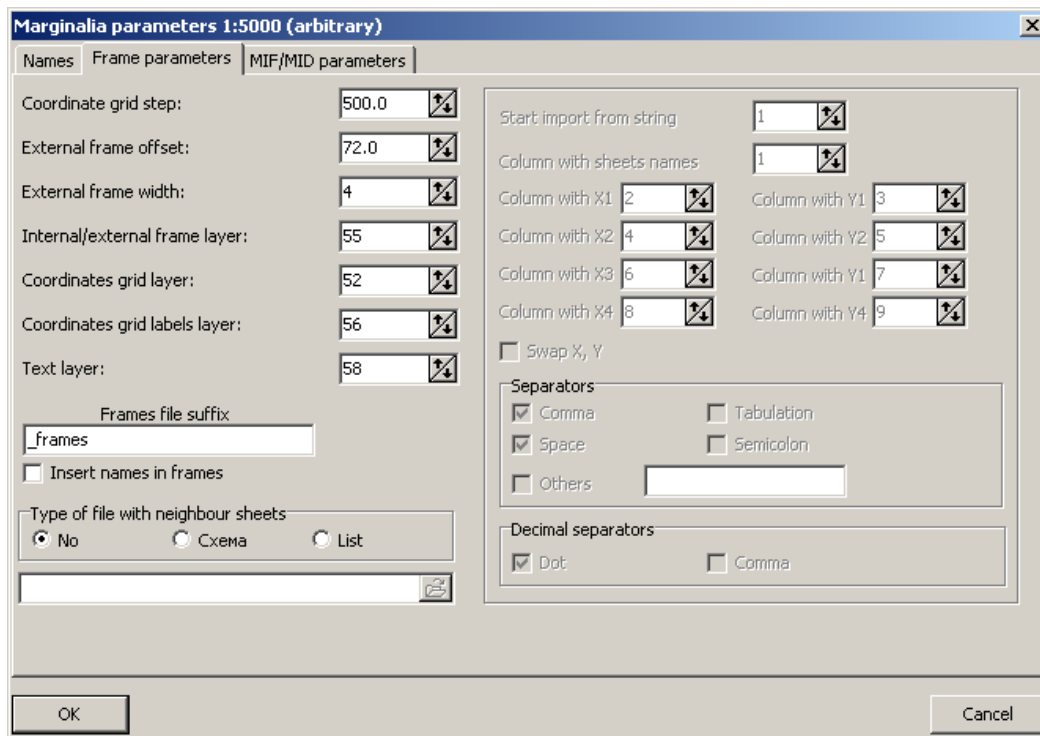
Edition of standard marginalia.

On the **Frame parameters** tab, besides frame and coordinate grid properties, you may select a file to load data on the nomenclature of neighborhood sheets which should be shown at each of the 4 sides of the sheet frame. In order to do this, in **Type of file with neighbor sheets** panel specify the path to the file containing neighborhood sheets nomenclature list, and set up the import parameters in the left panel.

There may be chosen one of the following **Type of file with neighbor sheets** values:

• **No** - names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

• **Scheme** - a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

Р-54-76-В-б-1,Р-54-76-В-б-2
Р-54-76-В-б-3, Р-54-76-В-б-4

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contains the name of the sheet and the eight coordinates of four vertices of sheet. For example:

-
Р-54-76-В-б-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0
Р-54-76-В-б-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0
Р-54-76-В-б-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0
Р-54-76-В-б-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0

12.7.2. Marginalia parameters

This section contains detailed description of marginalia creation parameters for all supported scales.

12.7.2.1. *Marginalia 1:2000*

12.7.2.1.1. MicroStation DGN

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:2000 | MicroStation DGN.**

This command brings up the following dialog box with parameters:

The **Names** tab contains the following parameters:
• **Path to marginalia files** - the directory where the sheets with marginalia will be saved. By default, this is the folder where orthophoto has been created. If the setting is changed, it is saved and used the next time.
• **Coord. system, Country, State, District** - Text lines placed consequently at the upper left corner of marginalia.
• **Caption, City** - Text lines placed consequently at the top center of marginalia.
• **Stamp** - Text line placed at the upper right corner of marginalia.
Next come 5 strings placed consequently at the bottom right corner of marginalia.
The fields for entering numeric values to the right of some text input fields specify horizontal shift of the corresponding lines. The shift is given in the units of the PHOTOMOD project (usually in meters).
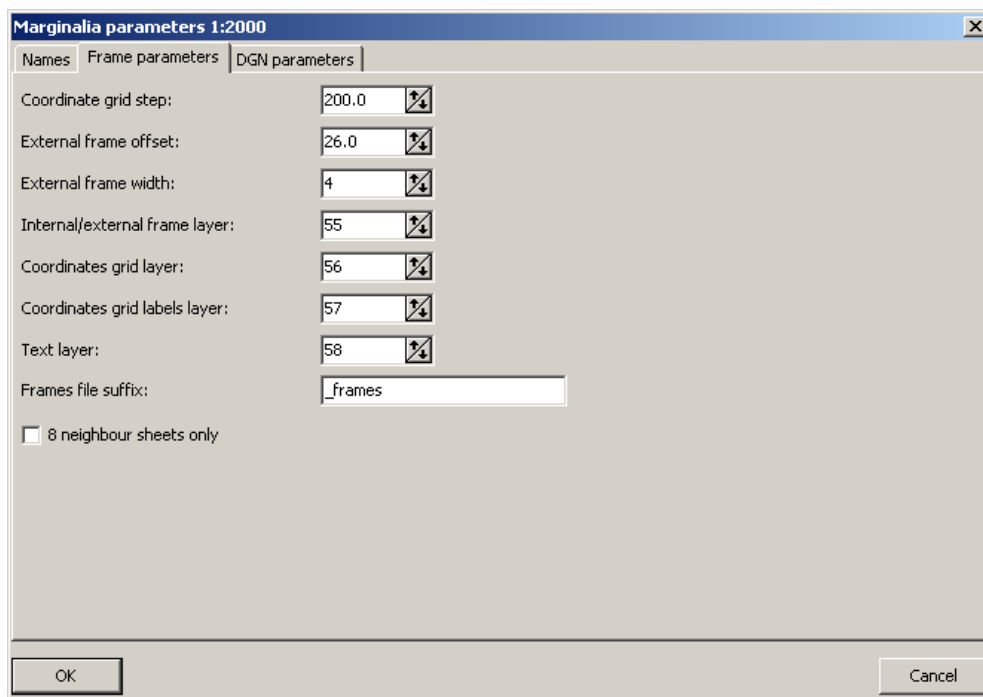
Frame parameters tab:
• **Coordinate grid step** specifies the distance between the lines of grid on marginalia.
• **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image.
• **External frame width** specifies thickness of external (thickened) frame.
• **Internal / external frame layer, Coordinates grid layer, Coordinates grid labels layer** and **Text layer** specify the layer numbers (in DGN file) on which the relevant information is placed.
• **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames.
• **8 neighbour sheets only** option constrains the sheet scheme situated in the left bottom corner by 9 sheets. Current sheet is placed in the center, with not more than 8 neighbour sheets around it.

DGN parameters tab:

The tab is used for setting standard DGN v7 parameters
• Names for **MU** and **SU** units
• Ratios MU / SU and SU / Pos.Units
• Origin of coordinates in a file - automatic selection or manual setting.

12.7.2.1.2.   MapInfo MIF/MID

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:2000 | MapInfo MIF/MID.**
This command brings up the following dialog box with parameters:
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN format.
Frame parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN format.
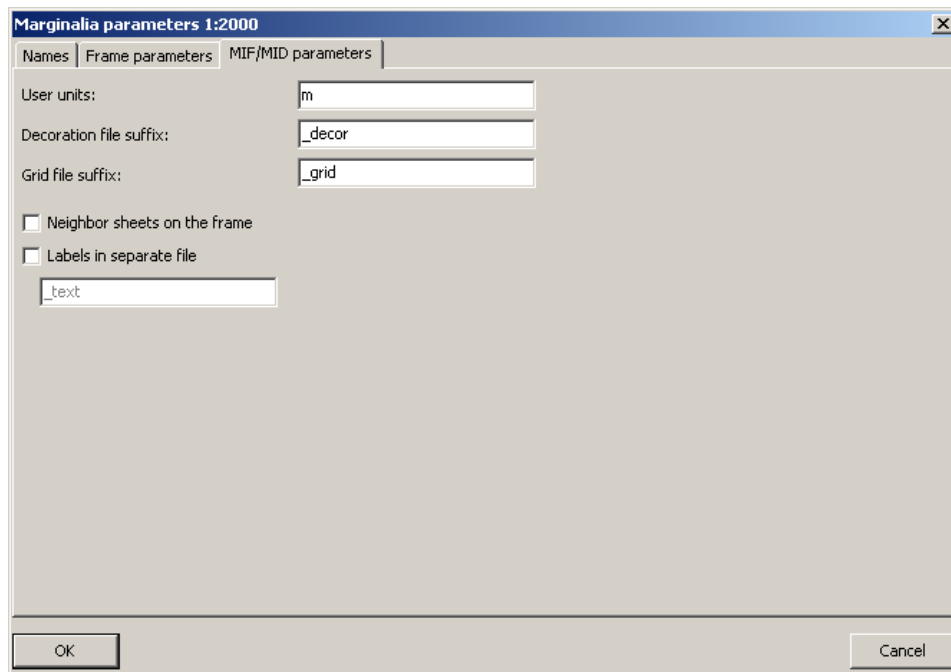
MIF / MID parameters tab :
• **User units** field specifies the name of the units of measurement in the MIF / MID file.

• **Decoration file suffix** and **Grid file suffix** fields specify the lines which are appended to the base name of the sheet to obtain separate files with corresponding data.

• **Neighbour sheets on the frame** option allows, along with the scheme of sheets in the lower left corner, insert the names of the neighbour sheets in the cut-outs of the external (thickened) frame.

• **Labels in separate file** option allows to save all text captions in a separate file with the specified suffix.

12.7.2.1.3.   MicroStation DGN (arbitrary)

Marginalia is created using the menu command **Mosaic | Create marginalia 1:2000 | MicroStation DGN (arbitrary).**
This command brings up the following dialog box with parameters:

Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard, except for additional **Contours** and **Elevation system** parameters, which specify two text strings, which are written consequently at the center bottom.

Frame parameters tab:

• **Coordinate grid step** specifies the distance between the lines of grid on marginalia.

• **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image.

• **External frame width** specifies thickness of external (thickened) frame.

• **Internal / external frame layer, Coordinates grid layer, Coordinates grid labels layer** and **Text layer** specify the layer numbers (in DGN file) on which the relevant information is placed.

• **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames.

• **Insert names in frames** option causes writing the names of sheets to a file with frames not only into the corresponding attribute, but also as a text string.

There may be chosen one of the following **Type of file with neighbor sheets** values:

• **No** - names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.

• **Scheme** - a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

     Р-54-76-В-б-1,Р-54-76-В-б-2
     Р-54-76-В-б-3, Р-54-76-В-б-4

• **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four vertices of sheet. For example:

•
     Р-54-76-В-б-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0
     Р-54-76-В-б-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0
     Р-54-76-В-б-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0
     Р-54-76-В-б-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0

• **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines.

• **Column with sheets names** - number of CSV column, which contains the names of the sheets.

• **Column with X1** - **Column with X4**, **Column with Y1** - **Column with Y4** parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners.

• **Swap X, Y** - if this option is checked then during import X and Y coordinates of objects vertices are swapped.

• The **Separators** panel is used to select the symbols that separate fields in the CSV file; comma and space are selected as separators by default.

Frame parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

12.7.2.1.4. MapInfo MIF/MID (arbitrary)

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:2000 | MapInfo MIF/MID (arbitrary).**
This command brings up the following dialog box with parameters.
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN (arbitrary) format.
Frame parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN (arbitrary) format.
MIF/MID parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in MIF/MID format.

12.7.2.2. *Marginalia 1:5000*

12.7.2.2.1. MicroStation DGN

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:5000 | MicroStation DGN.**

This command brings up a dialog box with parameters, which is identical to the one in the parameters dialog for 1:2000 marginalia in DGN format.

12.7.2.2.2. MapInfo MIF/MID

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:5000 | MapInfo MIF/MID.**

This command brings up a dialog box with parameters, which is identical to the one in the parameters dialog for 1:2000 marginalia in MIF/MID format.

12.7.2.2.3. MicroStation DGN (arbitrary)

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:5000 | MicroStation DGN (arbitrary).**

This command brings up the following dialog box with parameters.

Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

Frame parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN (arbitrary) format.

DGN parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

12.7.2.2.4. MapInfo MIF/MID (arbitrary)

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:5000 | MapInfo MIF/MID (arbitrary).**

This command brings up the following dialog box with parameters.

Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

Frame parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia in DGN (arbitrary) format.

MIF/MID parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in MIF/MID format.

12.7.2.3. *Marginalia 1:10 000*

12.7.2.3.1. MicroStation DGN

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:10 000 | MicroStation DGN.**

This command brings up the following dialog box with parameters.

Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

Frame parameters tab:
• **Coordinate grid step** specifies the distance between the lines of grid on marginalia.
• **External frame offset** specifies the indentation of external (thickened) frame from the frame along the outer edges of the corresponding image.
• **External frame width** specifies thickness of external (thickened) frame.
• **Internal / external frame layer, Coordinates grid layer, Coordinates grid labels layer** and **Text layer** specify the layer numbers (in DGN file) on which the relevant information is placed.
•   **Rename to work number** option causes renaming of the sheet (trapezoid) name in the upper right corner and in the cut-out of external (thickened) frame to the work number. This requires the CSV file having both names of the sheets (the column number is defined by a *column with the nomenclature* parameter) and work numbers (the columns number is defined by the *column with numbers of trapezoid* parameter).
•   **Add sheet work name** option causes appending the work number of trapezoid to name of the sheet in parentheses at the top right corner of marginalia.
For example: "P-54-76-B-b-1" -> "P-54-76-B-b-1 (49)"
• **Frames file suffix** specifies a text line attached to the base sheet name to get the combined file name with all created sheets frames.
•   **Delete first letter** of nomenclature option causes deleting the first symbol in the nomenclature of the sheet.
For example: "P-54-76-B-b-1" -> "54-76-B-b-1"
There may be chosen one of the following **Type of file with neighbor sheets** values:
•   **No** -   names of the neighbor sheets are calculated automatically based on the SK-42 topomaps nomenclature.
•   **Scheme** -   a CSV file is used as the scheme file, which contains only the sheet names in accordance with the sheets topology. Row numbers correspond to north-south direction. Column numbers correspond to west-south direction. For example:

    P-54-76-В-б-1,P-54-76-В-б-2
    P-54-76-В-б-3, P-54-76-В-б-4

- **List** – file in the CSV format, containing description of one sheet in each line. The line should contain the name of the sheet and the eight coordinates of four   vertices of sheet. For example:

  P-54-76-В-б-3,1848.0,824.0,5848.0,824.0,5848.0,4824.0,1848.0,4824.0
  P-54-76-В-б-4,5848.0,824.0,9848.0,824.0,9848.0,4824.0,5848.0,4824.0
  P-54-76-В-б-1,1848.0,4824.0,5848.0,4824.0,5848.0,8824.0,1848.0,8824.0
  P-54-76-В-б-2,5848.0,4824.0,9848.0,4824.0,9848.0,8824.0,5848.0,8824.0

- **Start import from string** option causes the import process to start from the given line in the file, skipping the previous lines.
- **Column with sheets names** - number of CSV column, which contains the names of the sheets.
- **Column with X1** - **Column with X4**, **Column with Y1** - **Column with Y4** parameters - define the numbers of CSV columns, which contain corresponding coordinates of the sheets corners.
- **Swap X, Y** - if this option is checked then during import X and Y coordinates of objects vertices are swapped.
- The **Separators** panel is used to select the symbols that separate fields in the CSV file; comma and space are selected as separators by default.

Frame parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

12.7.2.3.2.   MapInfo MIF/MID

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:10 000 | MapInfo MIF/MID.**
This command brings up the following dialog box with parameters.
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.
Frame parameters tab is identical to the one in the parameters dialog for 1:10 000 marginalia in DGN format.
MIF/MID parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in MIF/MID format.

12.7.2.4. *Marginalia 1:25 000*

12.7.2.4.1.   MicroStation DGN

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:25 000 | MicroStation DGN.**
This command brings up the following dialog box with parameters.
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.
Frame parameters tab is identical to the one in the parameters dialog for 1:10 000 marginalia in DGN format.
DGN parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

12.7.2.4.2.   MapInfo MIF/MID

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:25 000 | MapInfo MIF/MID.**
This command brings up the following dialog box with parameters.
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.
Frame parameters tab is identical to the one in the parameters dialog for 1:10 000 marginalia in DGN format.
MIF/MID parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in MIF/MID format.

12.7.2.5. *Marginalia 1:50 000*

12.7.2.5.1.   MicroStation DGN

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:50 000 | MicroStation DGN.**
This command brings up the following dialog box with parameters.
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.
Frame parameters tab is identical to the one in the parameters dialog for 1:10 000 marginalia in DGN format.
DGN parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.

12.7.2.5.2.   MapInfo MIF/MID

Marginalia is created using the menu command **Mosaic | Create Marginalia 1:50 000 | MapInfo MIF/MID.**
This command brings up the following dialog box with parameters.
Names tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in DGN format.
Frame parameters tab is identical to the one in the parameters dialog for 1:10 000 marginalia in DGN format.
MIF/MID parameters tab is identical to the one in the parameters dialog for 1:2000 marginalia standard in MIF/MID format.

12.8. *Distributed creation of orthomosaic*

Distributed creation of orthomosaic using multiple computers of the local network is possible when splitting of output mosaic into sheets is enabled. Detailed information on setting up PHOTOMOD for distributed processing is given in the **PHOTOMOD Overview User Manual**. The tasks for distributed mosaic creation are created in PHOTOMOD Mosaic module by the menu command **Mosaic | Distributed mosaic**.
For the distributed mosaic creation to be possible, the following conditions must be met:
- PHOTOMOD must be properly setup for the distributed processing on the computer (see **PHOTOMOD Overview User Manual**)
- Splitting into sheets mode must be set to **Regular splitting** or **Sheets extents from resources** (see chapter Splitting mosaic into map sheets)
- Mosaic project must not contain unsaved changes (i.e. it must be saved before creating the tasks).

This conditions are checked automatically and if any not met, corresponding error message pops up. Otherwise if everything is correct, the **Distributed mosaic creation** dialog is brought up.
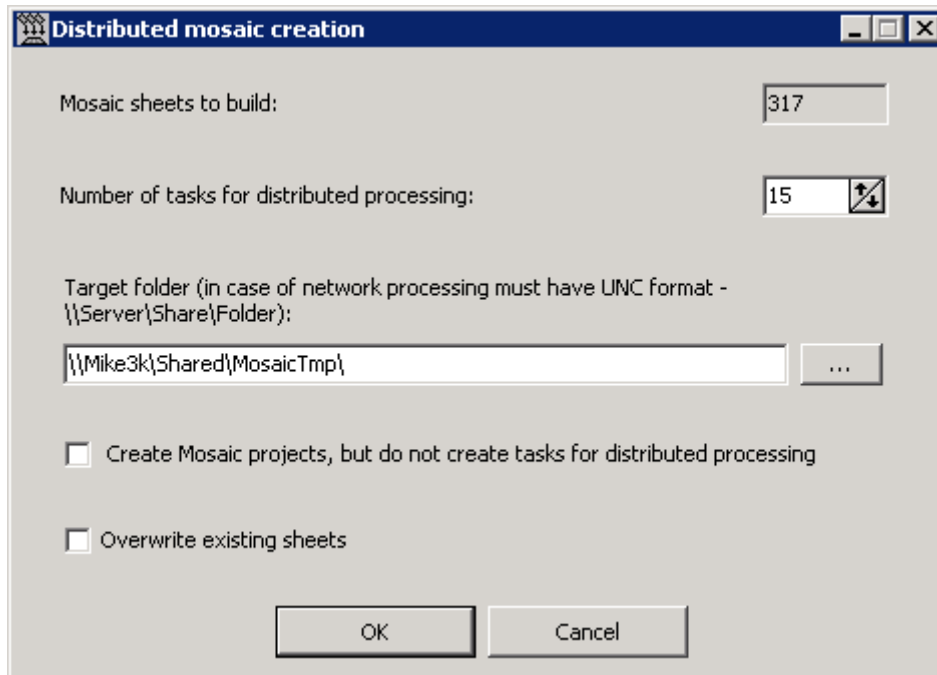
This dialog contains the following fields:
- **Mosaic sheets to build** - read-only information field showing the total quantity of sheets to be created
- **Number of tasks for distributed processing** - sets the number of tasks for processing which should be created. Each task contains creation of an integer number of sheets and is executed by single Mosaic process. Number of tasks lays in range from 1 to the total quantity of mosaic sheets. It is recommended to set this number something higher than the total maximum number of simultaneously executing tasks in the network, which is displayed in the status panel of the **Computers** groupbox of the **State monitoring** window.
- **Target folder** - output folder where the output sheets should be saved. If more than one computer is used for processing and it is required that all sheets are saved in one folder, the path must be given in UNC format (i.e. **\\Computer\Share\Path**). Otherwise, if the folder is specified like **C:\SomeFolder**, the output sheets will be saved in **C:\SomeFolder** folder of each computer involved. In some cases such capability may be useful.
- **Create Mosaic projects, but do not create tasks for distributed processing** - an auxiliary feature which may be used if it is necessary just to split Mosaic project into several subprojects containing approximately equal number of sheets. If this option is checked, no tasks for distributed processing are created; instead, in the resource folder where the source Mosaic project is saved, the given number of new projects is created having names in the form **<source project name>_pp_<num>**, where **num** ranges from 1 to the value of **Number of tasks** field.
- **Overwrite existing sheets** - if output files already exist in the target folder and this option is checked, those files are overwritten.

Note. In case of network processing, it is necessary to make sure that output folder is accessible for reading and writing from all the computers involved.

After the **OK** button is pressed, if the **Create Mosaic projects, but do not create tasks for distributed processing** has not been checked, the set of tasks is created and the **State monitoring** window is opened automatically (see **PHOTOMOD Overview User Manual**).

Further control of the distributed mosaic creation process is performed using the **PHOTOMOD System Monitor** as described in the mentioned Manual.

13. Export of orthomosaic to PHOTOMOD VectOr

PHOTOMOD VectOr is a GIS and Desktop Cartography module of **PHOTOMOD** system, used basically for creating and printing out digital maps (see **VectOr** User Manual).

PHOTOMOD Mosaic supplies export of orthomosaic and corresponding DEM to **PHOTOMOD VectOr**.

To export orthomosaic to VectOr format, select menu command **Mosaic | Build!** and specify output file type as **VectOr (RSW)**.
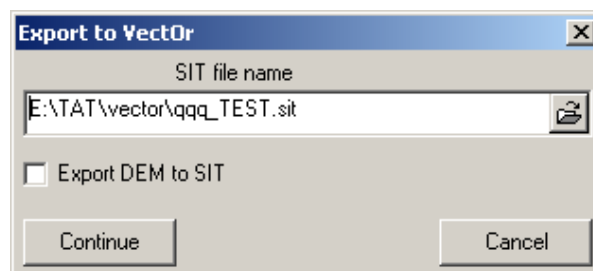
Map file selection dialog

In the window opened input the name and path of output mosaic in **SIT file name** field. If you need also to export DEM used for orthomosaic creation, mark the option **Export DEM to SIT**.

In case of new **VectOr** map creation you get a dialog with the following fields to be filled in:
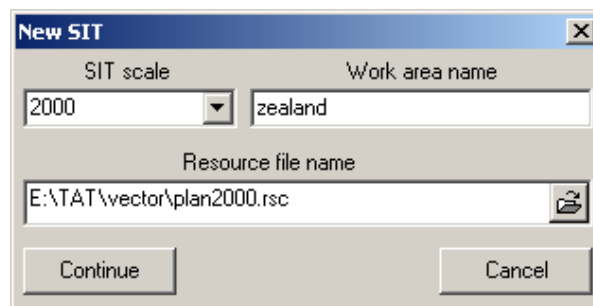
- **SIT scale** – select the scale of output orthoimage (1:2,000 by default)
- **Work area name** – arbitrary name of output map region (up to 31 character)
- **Resource file name** – name of file with a map symbol library (.rsc file). Several standard "classifiers" for different map scales are included to **PHOTOMOD** system (stored in PHOTOMOD \ VectOr folder). See also **PHOTOMOD VectOr** User Manual.

Note. Since VectOr always works with a left-handed coordinate system (X – to the north, Y – to the east) orthomosaic coordinates will be swapped accordingly

Click the button **Continue** to start creating orthophoto in **PHOTOMOD VectOr** format.

14. Georeference file

When the orthomosaic file is created, its georeference file is saved to the same folder. This file is used for referencing the mosaic to the coordinate system and has formats, described in the chapter PHOTOMOD Geo file, ArcWorld file and MapInfo file. The georeference file format is selected on the tab **Mosaic | Parameters | Orthoimage** (see the chapter Orthoimage).

Note. In case of mosaic export to GeoTIFF, VectOr, MicroStation, ERDAS Imagine the georeference information is stored directly in the file and the separate georeference file is not created

14.1. *PHOTOMOD Geo file*

PHOTOMOD georeference file has **.geo** extension and contains pixel and ground coordinates of 4 orthomosaic cells as well as cell size by X and Y axes in given units.

Example of geo file:

Orthomosaic created by PHOTOMOD 10.01.07
Units: (m)
Linscale: 8.600
Colscale: 8.600
(0.5, 0.5) (8271360.000 East, 1857514.200 North)
(0.5, 2446.5) (8271360.000 East, 1836470.000 North)
(2612.5, 0.5) (8293831.800 East, 1857514.200 North)
(2612.5, 2446.5) (8293831.800 East, 1836470.000 North)
Coordinate system: UTM, (North)

14.2. *Arc World file*

Georeference file, used by **Arc INFO** (**.tfw** extension at export to **TIFF** format)
Example of .tfw file:

1.000000
0.000000
0.000000
-1.000000
551286.128054
200588.824470

After orthomosaic export to other formats, georeference files (of text format likewise .tfw file) are created with the following extensions:

After export to **BMP** georeference file with **.bpw** extension is created.
After export to **JPG** georeference file with **.jgw** extension is created.
After export to **NITF** georeference file with **.nfw** extension is created.
After export to **DGN** georeference file with **.dgw** extension is created.
After export to **PNG** georeference file with **.pgw** extension is created.

14.3. *MapInfo file*

Georeference file, used by **MapInfo** (**.tab** extension)

Example of .tab file:

!table
!version 300
!charset WindowsLatin1

Definition table
 File "mosaic.tif"
 Type "RASTER"
 (143424.937,2635592.133) (0,0) Label "Point 1",
 (224834.937,2635592.133) (1163,0) Label "Point 2",
 (143424.937,2565592.133) (0,1000) Label "Point 3",
 (224834.937,2565592.133) (1163,1000) Label "Point 4"
 CoordSys Earth Projection 8, 104, "m", 33.000000, 0.000000, 0.999600, 500000.000000,
0.000000